

LONDON- WEST MIDLANDS ENVIRONMENTAL STATEMENT

Volume 5 | Technical Appendices

CFAg | Central Chilterns

Survey reports (CH-004-009)

Cultural heritage

November 2013

ES 3.5.2.9.7

LONDON-WEST MIDLANDS ENVIRONMENTAL STATEMENT

Volume 5 | Technical Appendices

CFAg | Central Chilterns

Survey reports (CH-004-009)

Cultural heritage



Department
for Transport

High Speed Two (HS2) Limited has been tasked by the Department for Transport (DfT) with managing the delivery of a new national high speed rail network. It is a non-departmental public body wholly owned by the DfT.

A report prepared for High Speed Two (HS2) Limited.

High Speed Two (HS2) Limited,
Eland House,
Bressenden Place,
London SW1E 5DU

Details of how to obtain further copies are available from HS2 Ltd.

Telephone: 020 7944 4908

General email enquiries: HS2enquiries@hs2.org.uk

Website: www.hs2.org.uk

High Speed Two (HS2) Limited has actively considered the needs of blind and partially sighted people in accessing this document. The text will be made available in full on the HS2 website. The text may be freely downloaded and translated by individuals or organisations for conversion into other accessible formats. If you have other needs in this regard please contact High Speed Two (HS2) Limited.



Printed in Great Britain on paper
containing at least 75% recycled fibre.

Contents

1	Introduction	3
1.1	Structure of the cultural heritage appendices	3
1.2	Surveys undertaken	3
1.3	Surveys proposed but not undertaken	3
2	Remote sensing survey report	3
2.1	Introduction	3
2.2	Methodology	4
2.3	Limitations	6
2.4	Assumptions	7
2.5	Results: description	7
2.6	Results: interpretation	14
2.7	Conclusions	14
2.8	References	14
2.9	Historic aerial photographs consulted	15
2.10	Figures	18
3	Geophysical surveys	19
3.1	Site MVoAB: Mantles Wood (CCo19)	19
3.2	References	20
3.3	Figures	20

List of figures

CH004.09.01	Remote sensing survey interpretation	1:5,000
CH004.09.02	Remote sensing survey interpretation	1:5,000
CH004.09.03	Remote sensing survey interpretation	1:5,000

CH004.09.04	Remote sensing survey interpretation	1:5,000
CH004.09.05	Remote sensing survey interpretation	1:5,000
CH004.09.06	Location plan of survey area	1:25000
CH004.09.07	Location of survey grids and referencing	1:1000
CH004.09.08	Colour plot of gradiometer data	1:1000
CH004.09.09	Plot of minimally processed gradiometer data	1:1000
CH004.09.10	Abstraction and interpretation of gradiometer anomalies	1:1000

List of tables

Table 1:	Layers used in GIS for digital transcription of archaeological features	5
Table 2:	Period range abbreviations used in the GIS attribute data	6
Table 3:	Evidence abbreviations used in the GIS attribute data	6
Table 4:	Exported GIS attribute data for each transcribed feature, detailing the interpretation applied	8
Table 5:	English Heritage vertical aerial photographs consulted for the remote sensing survey of CFAg	15
Table 6:	English Heritage oblique aerial photographs consulted for the remote sensing survey of CFAg	17
Table 7:	Cambridge University Collection of Aerial Photography aerial photographs consulted for the remote sensing survey of CFAg	18

1 Introduction

1.1 Structure of the cultural heritage appendices

- 1.1.1 The cultural heritage appendices for the Central Chilterns community forum area (CFA9) comprise:
- baseline reports (Volume 5: Appendix CH-001-009);
 - a gazetteer of heritage assets (Volume 5: Appendix CH-002-009);
 - an impact assessment table (Volume 5: Appendix CH-003-009); and
 - survey reports (this appendix).
- 1.1.2 Maps referred to throughout the cultural heritage appendices are contained in the Volume 5, Cultural Heritage Map Book.
- 1.1.3 Where appropriate, sites or assets discussed within report have been cross referenced with the gazetteer of heritage assets (Volume 5: CH-002-009) via the unique identifiers, and can be viewed on maps CH-01-029, CH-01-029-L1, CH-01-030, CH-01-030-L1 and CH-02-014 in the Volume 5, Cultural Heritage Map Book.

1.2 Surveys undertaken

- 1.2.1 This appendix contains the results of a series of archaeological surveys. These surveys comprised:
- a fully-integrated remote sensing survey incorporating light detection and ranging (LiDAR), hyperspectral imagery and aerial photographic analysis of the majority of the Proposed Scheme; and
 - a geophysical survey at one location along the route (site code: MVoAB), encompassing approximately 2ha.

1.3 Surveys proposed but not undertaken

- 1.3.1 In addition to the surveys reported on in this document, a number of additional locations within the Central Chilterns study area were proposed for geophysical survey but due to access or other restrictions these surveys were not carried out. The locations of these proposed surveys are:
- land between Chapel Farm and Chesham Road, Hyde Heath (CC035 national grid reference: SP 91232 01061);
 - land between Chesham Road and Frith Hill, Hyde Heath (CC064; national grid reference: SP 90609 01553);
 - Potter Row, Hyde Heath (CC077; national grid reference: SP 90354 02046); and
 - Grim's Ditch (national grid reference: SP 89186 03873; this asset is discussed within the Dunsmore, Wendover and Halton study area (CFA10) under the unique identifier DWH008).

2 Remote sensing survey report

2.1 Introduction

- 2.1.1 This report outlines the results of the archaeological remote sensing survey of CFA9. This was an archaeological survey involving the systematic analysis, interpretation, mapping and recording of archaeological sites from aerial photographs, hyperspectral imagery and LiDAR imagery.
- 2.1.2 The aim was to map and record the form and extent of archaeological features visible as cropmarks, soilmarks, earthworks or structures on a range of different remote sensed imagery for the study area, in order to inform the baseline assessment of the cultural heritage resource. The objective was thereby to facilitate the assessment of impact and the formulation of mitigation strategies.
- 2.1.3 The study area has not been covered by an English Heritage National Mapping Programme project. The Thames Valley National Mapping Programme project area¹ falls to the south-west and the area covered by the Hertfordshire project area² lies to the north-east. Therefore there is no existing systematic survey of archaeological features visible on remote sensed sources for the study area.

The study area

- 2.1.4 The study area for this remote sensing survey covers the entire length of CFA9 which falls entirely within Buckinghamshire.
- 2.1.5 The study area generally comprised a 700m-wide strip centred on the route (350m either side of the centre line). This provided a buffer sufficient to offer contextual information for all recorded sites. Where the Proposed Scheme boundary extended beyond the edge of the 700m-wide strip, the study area was expanded to the limit of the remote sensing survey boundary shown in Figures CH004.09.01 to CH004.09.05.
- 2.1.6 One such example of this is a small extra area amongst woodland between Hyde Heath and Little Kingshill, just to the south-west of the route. This area is detached from the main generally linear study area. No features were recorded here from the remote sensed imagery, though it was included in the survey.
- 2.1.7 In total the archaeological remote sensing survey for the Central Chilterns study area covered an area of 4.7km².

¹ Fenner, V.E.P., (1994), *The Thames Valley Project: a report for the National Mapping Programme*, RCHME Aerial Survey Report Series.

² Fenner, V.E.P., (1992), *Crop Marks in Hertfordshire: a report for the National Mapping Programme*, RCHME internal document.

2.2 Methodology

2.2.1 In order to provide consistency with other similar datasets, namely English Heritage National Mapping Programme mapping, the archaeological remote sensing survey was carried out in broad accordance with the current version of the English Heritage National Mapping Programme standards³. The interpretations applied to identified features are consistent with the preferred terms within the English Heritage Monument Type Thesaurus.⁴

Sources: modern aerial photographs

- 2.2.2 High resolution (12.5cm) vertical aerial orthophotography taken specifically for the purposes of the project was made available for this survey. This imagery was captured during 2012. It generally consists of a 700m-wide strip centred on the route, although it is slightly wider in some areas. It was viewed digitally within a geographical information system (GIS) program. The level of accuracy of the orthorectification is such that features mapped from this source should be within 15cm of true ground position.
- 2.2.3 Pre-existing vertical aerial orthophotography dating from the 1990s and 2000s was also made available for this study. This was supplied under the Pan-Government Agreement. The resolution is 25cm. The level of accuracy of the orthorectification is such that features mapped from this source should be within 1.5m of true ground position.⁵ This vertical imagery was also viewed on-screen within GIS.

Sources: historic aerial photographs

- 2.2.4 All readily available historic vertical and oblique aerial photographs held in archives were also consulted for this project. This included photographs held at the English Heritage Archive (formerly the National Monuments Record) and the Cambridge University Unit for Landscape Modelling. The latter is also referred to as the Cambridge University Collection of Aerial Photography.
- 2.2.5 The 111 historic vertical aerial photographs of the study area in the English Heritage Archive (Table 5) were taken for non-archaeological purposes between 1946 and 1994, by organisations such as the Royal Air Force (RAF) and the Ordnance Survey (OS). These photographs often captured sites of historic interest incidentally, especially those shots taken in the first half of the 20th century before archaeological remains may have been damaged or destroyed by the intensification of arable farming.
- 2.2.6 The 71 historic oblique aerial photographs of the study area in the English Heritage Archive (Table 6) were taken between 1931 and 2011 and usually targeted known sites of architectural or archaeological interest. They were typically taken at a much larger scale than the 'blanket' vertical aerial photography and were often timed to capture images of archaeological sites

when they were at their most visible, i.e. when dry ground conditions favoured the development of clear cropmarks, or when low winter sun would reveal subtle earthworks.

- 2.2.7 Twelve Cambridge University Collection of Aerial Photography aerial photographs fell within the study area (Table 7). These were vertical and oblique aerial photographs dating from between 1982 and 1985. As with the English Heritage aerial photographs the oblique photographs are more likely to have been taken for archaeological purposes than the vertical photographs. The vertical aerial photographs, however, still had the potential to inadvertently capture evidence of archaeological remains.
- 2.2.8 All aerial photographs in the English Heritage and Cambridge University Collection of Aerial Photography archives which fell within the study area were viewed in person and examined stereoscopically and under magnification where applicable. Copies were obtained where potential archaeological features were identified and the relevant photographs were considered to be of use either for transcription or for reference purposes.

Sources: LiDAR imagery

- 2.2.9 High resolution LiDAR data was made available for this survey. This data was captured in 2012. It generally consists of a 700m-wide strip centred on the route although it is slightly wider in some areas.
- 2.2.10 The resolution of the data supplied was 20cm. The level of accuracy of the orthorectification was such that features mapped from this source should be within 15cm of true ground position. The raster digital elevation model was viewed directly within GIS. The digital elevation model is LiDAR data that has been processed to provide a representation of the ground surface without objects such as vegetation or buildings. This means that archaeological earthworks can be revealed on the LiDAR imagery even if they lie beneath areas of woodland.⁶

Sources: hyperspectral imagery

- 2.2.11 Hyperspectral imagery taken specifically for the purposes of the Proposed Scheme was made available for this survey. This imagery was captured during a series of 'runs' in 2012 and provides a considerable buffer beyond the edge of the remote sensing survey study area boundary.⁷
- 2.2.12 Thirty-four separate spectral band widths were captured ranging from 406.075 nanometres to 992.065 nanometres. The band widths varied slightly between 16.280 nanometres, at the lower end of the spectrum, to 18.280 nanometres.⁸ For each of the areas surveyed, varying combinations of three different bandwidths were analysed, with particular reference to bands 7–13 (882.725 nanometres to 773.255 nanometres) and bands 18–22 (683.435 nanometres to

³ Winton, H., (2012), *Standards for National Mapping Programme projects, Version 0.1 'Draft'*, English Heritage, Aerial Investigation and Mapping, Typescript document

⁴ English Heritage; NMR Monument Type Thesaurus; http://thesaurus.englishheritage.org.uk/thesaurus.asp?thes_no=1; Accessed: August 2012–June 2013.

⁵ GeoStore; Aerial Photography RGB Product; <http://www.geostore.com/geostore4/WebStore?xml=geostore4/xml/productsAPRGB.xml>; Accessed: August 2013.

⁶ This can sometimes depend upon the time of year that the LiDAR imagery was captured.

⁷ Hyperspectral runs 4Ra and 5Rb covered CFA9.

⁸ Blom, (2012), *HS2 Hyperspectral Information*, BLOM Project Number: 03/037/12.

612.185 nanometres), as these have been shown previously to be useful in archaeological remote sensing.⁹

2.2.13 The hyperspectral imagery was viewed directly within GIS as automated classification software does not work well with such high resolution data due to the prolifically varied response obtained from a single small area.¹⁰

Sources: historic environment record (HER) data

2.2.14 Data from the Buckinghamshire HER was supplied for the purposes of this study. These records were used as a reference to aid interpretation of features visible on remote sensed imagery, either through a pre-existing identification of a visible feature, or by providing information that could help characterise the likely cultural heritage resource of the area.

2.2.15 The HER data was supplied as points, lines and polygons with identifying attribute data attached. Full monument record reports were also supplied as a portable document format document. The data supplied covered the entirety of the Buckinghamshire HER area, creating an ample buffer to provide contextual information for any archaeological sites of interest, within the boundary of the remote sensing study area.

Sources: national Heritage List (NHL) data

2.2.16 Monument data from the NHL held by English Heritage, was supplied for the purposes of the project. This data was used as a reference to aid interpretation of features visible on remote sensed imagery, either through a pre-existing identification of a visible feature, or by providing information that could help characterise the likely cultural heritage resource of the area.

2.2.17 This data was supplied as points, lines and polygons with identifying attribute data attached. Full monument record reports were also supplied as a portable document format document. The data covered a 10km-wide strip (5km each side of the route centre line) thereby providing an ample buffer beyond the boundary of the remote sensing study area.

Sources: cartographic sources

2.2.18 Historic OS mapping was supplied for the purposes of the project. The map tiles had been geo-referenced and were viewed digitally in GIS. Epochs 1–4 of the 1:2500 scale County Series maps, which typically date from 1898 onwards, were used as a reference to aid interpretation of features visible on the remote sensed imagery.

2.2.19 In general where features such as field boundaries, trackways, extractive pits or ponds were marked on a historic OS map, they were not mapped and recorded as part of this survey. This is because the objective of this project was to add to the known record, not duplicate it.

Nevertheless, where the full extent or form of a feature was not recorded in its entirety on the historic maps, it was included in the transcription for this project.

Interpretation, rectification and mapping

2.2.20 All vertical and oblique images from the sources identified above were systematically examined for any archaeological features visible as cropmarks, soilmarks, earthworks or structures. In accordance with best practice for remote sensing surveys, all available sources for each field or land parcel were viewed in conjunction in order to enable the most accurate interpretation possible.

2.2.21 Where archaeological features were visible on the LiDAR or aerial orthophotography, a detailed transcription, including all visible elements of the site in question, was carried out in ArcMap 10.1.

2.2.22 Where additional sites, features or details were visible on the historic aerial photographs from the English Heritage Archive, these images were rectified using the computer program Aerial 5.33 prior to their import into ArcMap for transcription.

2.2.23 Digital OS MasterMap 1:1250 base maps were used to establish control points (it should be noted that even when 1:1250 scale data is obtained, the scale of the mapping for rural areas is only in fact 1:2500¹¹). Six or more control points were used for each photograph, with errors kept below 1m for each control point. This provided accuracy to within 1m to the base map for the rectified photographs.

2.2.24 A digital terrain model (DTM) in the form of 5m point data was used in order to further refine the accuracy of the rectifications. The DTM was supplied for the purposes of the project.

2.2.25 The OS advise that their 1:1250 scale MasterMap data has an accuracy of 0.5m root mean square error for urban areas and 1.1m root mean square error for rural areas.¹² Therefore, archaeological features transcribed from photographs rectified using this data will on average be accurate to within 1m–2m of their British national grid coordinates.

2.2.26 As already noted, in order to ensure consistency with other similar remote sensing datasets, this project was carried out in broad accordance with current National Mapping Programme standards and guidance. As such the identified features were transcribed onto the standards drawing layers conventions¹³ as detailed in Table 1.

Table 1: Layers used in GIS for digital transcription of archaeological features¹⁴

Layer name	Colour	Description
Bank	Red	Defines the outline of positive features such as boundary banks or windmill mounds. Thin banks, or those too diffuse to define accurately, are included on this layer as a single line.
Ditch	Green	Defines the outline of negative features such as boundary ditches or hollow ways. Thin ditches, or those too diffuse to define accurately, are included on this layer as a single line.

⁹ Powlesland, D., Lyall, J. and Donoghue, D., (1997), *Enhancing the record through remote sensing: the application and integration of multi-sensor, non-invasive remote sensing techniques for the enhancement of the Sites and Monuments Record*, *Internet Archaeology* 2; <http://dx.doi.org/10.11143/ia.2.4>; Accessed: 18 December 2012.

¹⁰ Powlesland, D., Lyall, J. and Donoghue, D., (1997)

¹¹ Ordnance Survey; Products and Services FAQs: How accurate are your products?; <http://www.ordnancesurvey.co.uk/oswebsite/support/products-services.html>; Accessed: June 2013.

¹² Ordnance Survey; Products and Services FAQs: How accurate are your products?; <http://www.ordnancesurvey.co.uk/oswebsite/support/products-services.html>; Accessed: June 2013..

¹³ Winton, H., (2012)

¹⁴ Table 1 based on Winton, H., (2012), Section 7.5. P31.

Layer name	Colour	Description
Large cut feature	Blue	Defines the outline of sizeable negative features such as quarries or extractive pits.
Levelled Ridge and Furrow outline or direction	Magenta	Defines the outline of a single block of ridge and furrow seen either as a cropmark or an earthwork later known to have been levelled. An arrow within each single block indicates the direction of ploughing.
Extant Ridge and Furrow outline or direction	Cyan	Defines the outline of a single block of ridge and furrow seen as earthworks on the latest available remote sensed imagery. An arrow within each single block indicates the direction of ploughing.
Extent of area	Grey	Defines the extent of large features such as the perimeters of WWII airfields and military camps.
T-hachure	Dark blue	Top of the 'T' defines the top of a slope or scarp edge such as a lynchet or house platform. Body of the 'T' indicates the length and direction of the slope.
Structure	Purple	Defines the extent of surviving buildings and structures such as individual WWII Nissen Huts and pillboxes. Thin structures such as walls or concrete paths are included in this layer as a single line.

2.2.27 Table 2 and Table 3 show period range and evidence range abbreviations used. The evidence abbreviations identify the form in which a feature is visible on the remote sensed imagery.

2.2.28 Information relating to each of the transcribed features was recorded in the ArcMap attribute table. This included details such as the interpretation of each feature and the remote sensed source they were transcribed from, as well as the HER and NHL data numbers for the features if applicable. These results have been set out in Table 4 of this report.

Table 2: Period range abbreviations used in the GIS attribute data

Period	Abbreviation	Date range
Neolithic	N	4,000 – 2,400 BC
Bronze Age	BA	2,400 – 700 BC
Iron Age	IA	700 BC – AD 43
Roman	RO	AD 43 – 410
Early medieval	EM	AD 410 – 1066
Medieval	MD	AD 1066 – 1540
Post-medieval	PM	AD 1540 to 1901
20 th century/modern	C20	AD 1901 – present
World War II	WWII	1939 to 1945
Uncertain	UN	

Table 3: Evidence abbreviations used in the GIS attribute data

Evidence	Abbreviation
Cropmark (includes soilmarks)	C

Evidence	Abbreviation
Earthwork	E
Levelled earthwork	LE
Destroyed monument (i.e. quarried-away)	DM
Structure	S

2.2.29 The results of this remote sensing survey and transcription have been saved in the project ArcMap MXD and have been supplied with all of the additional required metadata attached. The results have also been exported as Esri shapefiles for ease of import into other GIS programs where necessary in compiling the baseline survey.

2.3 Limitations

2.3.1 The survey was based on HER and NHL data obtained in 2012. Any information added to these databases after that time will not have been available as a reference during the course of this survey.

2.3.2 In some areas, the 2012 LiDAR and aerial orthophotography did not cover the full extent of the Proposed Scheme.

2.3.3 Where archaeological sites have been identified solely from remote sensed imagery without confirmation from archaeological excavation or supporting evidence in the form of find-spots etc., it should be noted that the interpretation may be revised in the light of further investigation.

2.3.4 It should be stressed that the absence of an archaeological feature on remote sensed imagery does not confirm its absence in the ground as visibility from the air is sometimes dependent upon a complex combination of factors. These include:

- unsuitable conditions at the time of image capture (such as lighting, ground moisture content and crops or other ground cover);
- variable quality of photography;
- underlying features being masked by alluvial build-up; and
- areas where archaeological features either do not survive or have never existed.

2.3.5 During the survey, 'steps' of approximately 2m were noted at several points in the purpose-flown 2012 vertical orthophotography, where adjacent image tiles had been joined to provide continuous coverage of the Proposed Scheme. This issue was escalated as appropriate was notified of this anomaly.

2.3.6 Archaeological features were not mapped beyond the boundary of the remote sensing survey study area, as the cumulative effect of this along the entire length of the route would have resulted in a significant increase in the study area. Where archaeological cropmarks, earthworks, soilmarks or structures continued beyond the study area boundary, this was noted in the attribute data of the mapped feature.

2.3.7 The hyperspectral imagery obtained for the purposes of the project did not include spectral bands in the short-wave to mid-infrared/thermal wavelengths (2080 nanometres – 13000 nanometres), which have been shown in the past to be of particular use in assessing archaeological potential. The mid-infrared/thermal range is especially likely to reveal subtle cropmarks or soilmarks that are not strong enough to be detectable in the visible part of the spectrum due to the fact it will display very slight differences in water content present within both vegetation and the ground¹⁵.

2.4 Assumptions

2.4.1 Information on the positional accuracy of the hyperspectral imagery has not been supplied. As such it is assumed that the accuracy of the orthorectification of this source is at least as good as that of the Aerial 5.33 program outlined in Section 2.2 of this report - i.e. transcribed features will be accurate to within 1m-2m of true ground position. Reference should, however, be made to the note in Section 2.3 of this report regarding the 2m ‘step’ observed in some locations.

2.5 Results: description

- 2.5.1 The primary output of the archaeological remote sensing survey of the study area is the detailed digital transcription of each identified potential archaeological feature. Information pertaining to the interpretation of these features is contained within the attribute data of every line and polygon drawn in GIS.
- 2.5.2 Table 4 itemises in detail the results of the survey. These details originate from the GIS attribute data. The results should be read in conjunction with Figures CH004.09.01 to CH004.09.05 of this report.
- 2.5.3 Where a single mapped feature has generated two lines of identical attribute data¹⁶ the duplicate line has been removed from Table 4. Where the transcription of a site or feature consists of several lines or polygons which may have been visible on different sources, or in a different form (i.e. where different elements of the site are visible as both cropmarks and earthworks), the differing lines of the attribute data table have been retained in order to reflect these variations.
- 2.5.4 The aerial survey ID is the unique identifier applied to each site or feature transcribed during this project. It was not considered sufficient to use the automatically generated ‘feature ID’ within GIS, as this would result in a site which consisted of several different features represented by different lines and polygons having several different identifying numbers. The aerial survey ID was also used to group features, such as several interconnecting former field boundaries. This is consistent with the approach taken by English Heritage on National Mapping Programme projects.¹⁷ The aerial survey ID is prefixed with a different sequential letter for each CFA; for the Central Chilterns study area it is the letter ‘I’.

- 2.5.5 The NHL and HER columns detail the relevant monument numbers for these authorities where such numbers exist for transcribed features.
- 2.5.6 The period abbreviations used are set out in Table 2.
- 2.5.7 As noted in Section 2.1 of this report the interpretation types (detailed in the Type column) comply with the preferred terms within the English Heritage Monument Type Thesaurus¹⁸ in order to achieve consistency with other similar transcribed datasets.
- 2.5.8 The evidence abbreviations refer to the physical nature of the recorded features. These abbreviations are set out in
- 2.5.9 Table 3.
- 2.5.10 The remote sensed imagery used to transcribe each individual feature is detailed in the source column.
- 2.5.11 The description column is intended as a brief interpretation only outlining the main features or points of note.
- 2.5.12 The full attribute table attached to every line and polygon transcribed as part of this survey contains additional columns not displayed in Table 4, such as the date the feature was transcribed and the initials of the member of staff responsible, etc.

¹⁵ Powlesland, D., Lyall, J. and Donoghue, D., (1997).
¹⁶ Such as a block of ridge and furrow, which contains this information within both the polygon that defines its extent and the line indicating the direction of ploughing.
¹⁷ Winton, H., (2012).

¹⁸ English Heritage, NMR Monument Type Thesaurus.

Table 4: Exported GIS attribute data for each transcribed feature, detailing the interpretation applied

Aerial Survey ID	NHL	HER	Period	Type	Evidence	Source	Description
I01	N/A	N/A	PM / UN	Mineral extraction site / natural feature	E	HS2 LiDAR 2012	Irregular and indefinable earthworks extend across this area. No clear pattern, just hummocky ground. May be a natural irregularity, but may also be the result of something like extraction of the underlying chalk. Nothing indicated on historic OS maps.
							Irregular, indefinable earthworks. No clear pattern, just hummocky ground. May be result of extraction of underlying chalk. Nothing indicated on historic OS maps. More pronounced in this area adjacent to river which would also have overlying alluvium.
I02	N/A	N/A	PM / UN	Extractive pit / quarry	E	HS2 LiDAR 2012	Group of hollows in what appears to be a garden at Kennel Farm. Possible former chalk pits. Not on historic OS maps. Not apparent on aerial photographs as they are shallow and smooth-edged but clearly visible on LiDAR.
I03	N/A	N/A	MD / PM	Field boundary / boundary bank	E	HS2 LiDAR 2012	Possible former field boundary visible as linear earthwork on LiDAR. Not on historic OS maps. Slightly irregular appearance may be due to possible later extractive activity in this area (I01).
I04 (CC001)	N/A	N/A	MD / PM	Field boundary / boundary bank	E	HS2 LiDAR 2012	Former field boundary visible as rectilinear earthwork beneath the trees of Keeper's Wood on LiDAR. Cut by later Metropolitan Railway (EH 1310465), as well as a trackway through the wood (marked on modern OS map).
							Former field boundary visible as rectilinear earthwork beneath the trees of Keeper's Wood on LiDAR. Degraded appearance due to later paths and trackways crossing the area.
				Ridge and furrow	E	HS2 LiDAR 2012	Possible ridge and furrow is very faintly visible on LiDAR as slightly extant earthworks beneath the trees of Keeper's Wood.
							Possible ridge and furrow is very faintly visible on LiDAR as slightly extant earthworks to the north of Keeper's Wood. Highly degraded appearance due to centuries of successive plough-leve lling.
				Ridge and furrow	C	NMR SU9398-1 NMR 18940-22 22-September-2000	Possible ridge and furrow is visible on oblique aerial photographs of 2000 as cropmarks.
I05 (CC001)	N/A	N/A	PM / UN	Extractive pit	E	HS2 LiDAR 2012	Sub-circular hollow which cuts the earlier ridge and furrow (I04) and which may have been for chalk extraction. Not recorded on historic OS maps. Visible beneath the trees of Keeper's Wood on the 2012 LiDAR.
I06 (CC001)	N/A	N/A	PM / UN	Extractive pit	E	HS2 LiDAR 2012	Sub-circular hollow which cuts the earlier ridge and furrow (I04) and which may have been for chalk extraction. Not recorded on historic OS maps. Visible beneath the trees of Keeper's Wood on the 2012 LiDAR.
I07 (CC001)	N/A	N/A	PM / UN	Extractive pit	E	HS2 LiDAR 2012	Sub-circular hollow which cuts the earlier ridge and furrow (I04) and which may have been for chalk extraction. Not recorded on historic OS maps. Visible beneath the trees of Keeper's Wood on the 2012 LiDAR.
I08 (CC008)	N/A	0628600000	PM / C20	Firing range / rifle butts	E	HS2 LiDAR 2012	A possible rifle butt structure is visible as earthworks at the base of an east-facing slope. Oval bank, with two oblong cut features within it. Possibly a base for the erection of a rifle target. Visible beneath trees of Lott's Wood on LiDAR.
							A possible rifle butt structure is visible as earthworks on an east-facing slope. A C-shaped bank is visible, with the 'open' part of the 'C' pointing towards the base of the slope. A further small length of bank occupies the open part of the 'C'.
I09	N/A	N/A	MD / PM	Field boundary / boundary bank	E	HS2 LiDAR 2012	A series of former boundary banks are faintly visible on LiDAR in the Parkview Cottages / Mill End Cottages area. Smooth profile and diffuse edges due to centuries of subsequent plough-leve lling. Not recorded on historic OS maps.
							A series of former boundary banks are faintly visible on LiDAR. Smooth profile and diffuse edges due to centuries of subsequent plough-leve lling. Not recorded on historic OS maps. Appears to have been bisected by something like a pipeline/service trench.
							A series of former boundary banks are faintly visible on LiDAR. Smooth profile and diffuse edges due to centuries of subsequent plough-leve lling. Not recorded on historic OS maps. Northern part of this stretch lies under formal gardens.
I10	N/A	N/A	MD / PM	Ridge and furrow	E	HS2 LiDAR 2012	Ridge and furrow is very faintly visible on LiDAR as almost completely ploughed-out earthworks in the field between Keeper's Wood and Lime Farm.
I11	N/A	N/A	PM / UN	Extractive pit / quarry	E	HS2 LiDAR 2012	Probable former extractive pit or quarry is visible on beneath the trees of The Coppice as an earthwork on LiDAR. Not recorded on historic OS maps.
I12	N/A	N/A	MD / PM	Field boundary /	E	HS2 LiDAR 2012	A former field boundary is visible on LiDAR as a linear earthwork. A continuation of the boundary between the two properties to the south-east. Likely to continue to north-west but not mapped as that is beyond the edge of both the project area and LiDAR

Aerial Survey ID	NHL	HER	Period	Type	Evidence	Source	Description
				boundary bank			coverage.
l13	N/A	N/A	PM / UN	Extractive pit / quarry	E	HS2 LiDAR 2012	Probable former extractive pit or quarry is visible on LiDAR as earthworks beneath the trees of Sibley's Coppice. LiDAR indicates considerable depth. Not recorded on historic OS maps.
l14 (CC007)	N/A	0828700000	PM / UN	Extractive pit / quarry	E	HS2 LiDAR 2012	A group of three former extractive pits are visible on LiDAR as earthworks beneath the trees of Bray's Wood. Westernmost pit partially indicated on modern and historic OS maps. Other two not indicated at all. Likely chalk extraction.
l15	N/A	N/A	MD / PM	Field boundary / boundary bank	E	HS2 LiDAR 2012	A possible field boundary or drainage ditch is visible as earthworks on LiDAR. Appears to lead NE-wards towards what may be a pond but this is not clear as it is just on the edge of the LiDAR coverage. Not recorded on modern or historic OS maps.
							A possible field boundary or drainage ditch is visible as earthworks on LiDAR. Appears to lead NE-wards towards what may be a pond but this is not clear as it is just on the edge of the LiDAR coverage. Not recorded on modern or historic OS maps.
l16	N/A	N/A	MD / PM	Field boundary / boundary bank	E	HS2 LiDAR 2012	A possible former field boundary bank is visible on LiDAR as a faint linear earthwork in the field to the north of Orchard Cottage. Not recorded on historic OS maps.
l17	N/A	N/A	MD / PM	Field boundary / boundary bank	E	HS2 LiDAR 2012	Two possible former field boundary banks are visible on LiDAR as greatly plough-spread parallel linear earthworks. Not recorded on historic OS maps.
l18	N/A	N/A	MD / PM	Field boundary / boundary bank	E	HS2 LiDAR 2012 / PGA SP9002 17-September-2003	A former field boundary bank is visible on both LiDAR and vertical aerial photographs as a very faint linear earthwork. Much plough-spread and almost completely levelled. Not recorded on historic OS maps.
l19	N/A	N/A	PM / UN	Extractive pit / quarry	E	HS2 LiDAR 2012	A possible former quarry pit is visible on LiDAR as a fairly pronounced, though smooth-edged hollow. Not recorded on historic OS maps. Underlying bedrock is chalk and the road on the northern side of this field is interestingly named 'Chalk Lane'.
l20	N/A	N/A	MD / PM	Field boundary / boundary bank	E	HS2 LiDAR 2012 / PGA SP9002 17-September-2003	A former field boundary bank is visible on both LiDAR and vertical aerial photographs as a very faint linear earthwork. Much plough-spread and almost completely levelled. Not recorded on historic OS maps.
l21 (CC017)	252033	0168800000	MD	Motte and bailey	E	HS2 LiDAR 2012	Medieval motte and bailey clearly visible as well-defined earthworks on LiDAR. Faint traces of a ditch beyond the bailey boundary bank are just visible on the eastern side. Sports pitch overlaps this ditch and the western edge of the bailey bank.
						HS2 LiDAR 2012 / NMR SP9299-2 NMR 24878-23 12-December-2007	Medieval motte and bailey clearly visible as well-defined earthworks on LiDAR. Western side of bailey bank and very western edge of motte clipped by field boundary. LiDAR shows earthworks continue under trees of coppice to the west. Scheduled monument number 1009534.
l22	N/A	N/A	MD / PM / UN	Trackway / boundary ditch	C / E	HS2 Vertical Photography SU9299 2012 / HS2 LiDAR 2012	Sinuuous linear ditch visible as a cropmark along its length and as a slight earthwork towards the northern end. Likely to continue to north-east but not mapped there as it is beyond both the remote sensed imagery coverage and the project boundary.
l23	N/A	N/A	MD / PM	Field boundary / boundary bank	E	HS2 LiDAR 2012	A former field boundary bank is visible on LiDAR as a linear earthwork crossing the north-east end of three modern fields/plots. Easternmost section cut by later ridge and furrow earthworks. Not recorded on historic OS maps.
							A former field boundary bank is visible on LiDAR as a linear earthwork crossing the north-east end of three modern fields/plots. Western most section under trees through a garden. Not recorded on historic OS maps.
l24 (CC066)	N/A	N/A	MD	Moat / bank	E	HS2 LiDAR 2012 / HS2 Vertical Photography SP9002 2012	Several sections of bank are visible flanking the remaining sections of the moat. It is not clear whether these are original or are in fact the result of later landscaping or just the trees and hedges not totally removed from the filtered LiDAR.
				Moat	E	HS2 LiDAR 2012 / HS2 Vertical Photography SP9002 2012	Several sections of the western half of the moat that once encircled this site (on 1st Edition OS map) are visible as earthworks on LiDAR. This section concealed beneath trees on aerial photographs. Adjoins a pond at its eastern end.
							Several sections of the western half of the moat that once encircled this site (on 1st Edition OS map) are visible as earthworks on LiDAR. This section differs to what is indicated on the modern OS map. It is narrower and there is an adjacent bank.
							Several sections of the western half of the moat that once encircled this site (on 1st Edition OS map) are visible as earthworks on LiDAR. This section is uncertain; it is a very shallow depression so may just be the result of later drainage or landscaping.

Aerial Survey ID	NHL	HER	Period	Type	Evidence	Source	Description
I25	N/A	N/A	MD / PM	Field boundary / boundary bank	E	HS2 LiDAR 2012	A possible former field boundary bank is visible on LiDAR as a very faintly extant linear earthwork. Cut by later ridge and furrow, which is also still faintly extant.
I26	N/A	N/A	PM / UN	Extractive pit	E	HS2 LiDAR 2012	Two possible former extractive pits are visible on LiDAR. Very similar appearance to the many dolines visible in the vicinity but with a banked rim that suggests that even if they had a natural origin they were later worked as chalk pits.
				Extractive pit / spoil heap	E	HS2 LiDAR 2012	Two possible former extractive pits are visible on LiDAR. Very similar appearance to the many dolines visible in the vicinity but with a banked rim that suggests that even if they had a natural origin they were later worked as chalk pits.
I27	N/A	N/A	MD / PM	Field boundary / boundary bank	E	HS2 LiDAR 2012	A possible former field boundary is faintly visible on LiDAR as an extant linear earthwork within these gardens. Not recorded on historic OS maps.
I28	N/A	N/A	MD / PM	Field boundary / boundary bank	E	HS2 LiDAR 2012	A possible former field boundary is faintly visible on LiDAR as an extant linear earthwork across this field. Many dolines also within this field. Not recorded on historic OS maps.
I29	N/A	N/A	MD / PM	Field boundary / boundary bank	E	HS2 LiDAR 2012	Former field boundary banks are visible on LiDAR as faintly extant rectilinear banks. Not recorded on historic OS maps. Considerable width due to centuries of plough-spreading. Almost levelled.
I30	N/A	N/A	MD / PM	Field boundary	C / E	PGA SP9299 17-SEPT-2003 / 23-April-2010 / HS2 LiDAR 2012	Possible former field boundaries visible as ditch cropmarks and very slight earthwork on LiDAR. Either in ditch form originally or negative feature created by later removal of bank or hedgerow. Joins trackway in centre marked on 1st Edition OS map.
I31 (CC019)	N/A	0942800000	PM / UN	Extractive pit / quarry	E	HS2 LiDAR 2012	String of small, perhaps explorative, quarry pits visible on LiDAR alongside a trackway beneath the trees of Mantle's Wood. Not recorded on historic OS maps. Underlying bedrock is chalk.
I32 (CC019)	N/A	N/A	PM / UN	Extractive pit / quarry	E	HS2 LiDAR 2012	Three quarry pits visible on LiDAR beneath trees of Mantle's Wood. Not recorded on historic OS maps. Underlying bedrock is chalk. All the pits in Mantle's Wood have been located further down the hillside than the superficial, overlying layer of clay.
I33 (CC019)	N/A	N/A	PM / UN	Extractive pit / quarry	E	HS2 LiDAR 2012	Former quarry pit visible on LiDAR beneath trees of Mantle's Wood. Not recorded on historic OS maps. Underlying bedrock is chalk. All the pits in Mantle's Wood have been located further down the hillside than the superficial, overlying layer of clay.
I34 (CC019)	N/A	N/A	PM / UN	Extractive pit / quarry	E	HS2 LiDAR 2012	Former quarry pit visible on LiDAR beneath trees of Mantle's Wood. Not recorded on historic OS maps. Underlying bedrock is chalk. All the pits in Mantle's Wood have been located further down the hillside than the superficial, overlying layer of clay.
I35 (CC019)	N/A	N/A	PM / UN	Extractive pit / quarry	E	HS2 LiDAR 2012	Former quarry pit visible on LiDAR beneath trees of Mantle's Wood. Not recorded on historic OS maps. Underlying bedrock is chalk. All the pits in Mantle's Wood have been located further down the hillside than the superficial, overlying layer of clay.
I36 (CC019)	N/A	N/A	PM / UN	Extractive pit / quarry	E	HS2 LiDAR 2012	Former quarry pit visible on LiDAR beneath trees of Mantle's Wood. Not recorded on historic OS maps. Underlying bedrock is chalk. All the pits in Mantle's Wood have been located further down the hillside than the superficial, overlying layer of clay.
I37 (CC019)	N/A	N/A	PM / UN	Extractive pit / quarry	E	HS2 LiDAR 2012	Former quarry pit visible on LiDAR beneath trees of Mantle's Wood. Not recorded on historic OS maps. Underlying bedrock is chalk. All the pits in Mantle's Wood have been located further down the hillside than the superficial, overlying layer of clay.
I38 (CC019)	N/A	N/A	PM / UN	Extractive pit / quarry	E	HS2 LiDAR 2012	Former quarry pit visible on LiDAR beneath trees of Mantle's Wood. Not recorded on historic OS maps. Underlying bedrock is chalk. All the pits in Mantle's Wood have been located further down the hillside than the superficial, overlying layer of clay.
I39 (CC019)	N/A	0942800000	PM / UN	Extractive pit / quarry	E	HS2 LiDAR 2012	Former quarry pit visible on LiDAR beneath trees of Mantle's Wood. Not recorded on historic OS maps. Underlying bedrock is chalk. All the pits in Mantle's Wood have been located further down the hillside than the superficial, overlying layer of clay.
I40 (CC019)	N/A	0942800000	PM / UN	Extractive pit / quarry	E	HS2 LiDAR 2012	Former quarry pit visible on LiDAR beneath trees of Mantle's Wood. Not recorded on historic OS maps. Underlying bedrock is chalk. All the pits in Mantle's Wood have been located further down the hillside than the superficial, overlying layer of clay.
				Spoil heap / quarry	E	HS2 LiDAR 2012	Quarry spoil heap visible on LiDAR beneath trees of Mantle's Wood. Not recorded on historic OS maps. Underlying bedrock is chalk. All the pits in Mantle's Wood have been located further down the hillside than the superficial, overlying layer of clay.

Aerial Survey ID	NHL	HER	Period	Type	Evidence	Source	Description
I41 (CC019)	N/A	0942800000	PM / UN	Extractive pit / quarry	E	HS2 LiDAR 2012	Former quarry pit visible on LiDAR beneath trees of Mantle's Wood. Not recorded on historic OS maps. Underlying bedrock is chalk. All the pits in Mantle's Wood have been located further down the hillside than the superficial, overlying layer of clay.
I42 (CC019)	N/A	0942800000	PM / UN	Extractive pit / quarry	E	HS2 LiDAR 2012	Former quarry pit visible on LiDAR beneath trees of Mantle's Wood. Not recorded on historic OS maps. Underlying bedrock is chalk. All the pits in Mantle's Wood have been located further down the hillside than the superficial, overlying layer of clay.
I43 (CC019)	N/A	0942800000	PM / UN	Extractive pit / quarry	E	HS2 LiDAR 2012	Former quarry pit visible on LiDAR beneath trees of Mantle's Wood. Not recorded on historic OS maps. Underlying bedrock is chalk. All the pits in Mantle's Wood have been located further down the hillside than the superficial, overlying layer of clay.
I44 (CC087)	N/A	0832200000	PM / UN	Extractive pit / quarry	E	HS2 LiDAR 2012	A series of quarry pits are visible on LiDAR as earthworks beneath the trees. Two are recorded on historic OS maps. The three largest have an HER record but the many smaller, perhaps exploratory, pits have not previously been recorded.
I45 (CC030)	N/A		PM / UN	Extractive pit / quarry	E	HS2 LiDAR 2012	Possible former quarry pit is visible on LiDAR as an earthwork beneath the trees of Farthings Wood. Not recorded on historic OS maps. Underlying bedrock is chalk. Overlaps/cuts into superficial layer of clay in northern half of the pit.
I46	N/A	0832400000	PM / UN	Extractive pit / quarry	E	HS2 LiDAR 2012	Two former extractive pits are visible on LiDAR as earthworks beneath the trees of an area of woodland. Only one of them was recorded on the historic OS maps and has an HER record.
I47	N/A		MD / PM	Field boundary / boundary bank	E	HS2 LiDAR 2012	A former boundary bank is visible on LiDAR as a linear earthwork across the eastern end of this field. Appears to be cut by later ridge and furrow.
I48 (CC095)	N/A	0828900000	PM / UN	Quarry / extractive pit	E	HS2 LiDAR 2012	An extensive area of chalk extraction is visible beneath trees on LiDAR as a series of adjoining pits and spoil heaps. Indicated on historic OS maps, but these only record around a quarter of the full extent of the quarrying.
I49	N/A	N/A	PM / UN	Extractive pit / quarry	E	HS2 LiDAR 2012	A probable extractive pit is visible on LiDAR as an earthwork beneath the trees of a small patch of woodland on the SE side of Cottage Farm. Not recorded on historic OS maps.
I50	N/A	N/A	PM / UN	Field boundary / boundary bank	E	HS2 LiDAR 2012	A slightly sinuous linear bank is visible on LiDAR as an earthwork beneath trees. Possibly a former field boundary bank. Not on historic OS maps.
I51	N/A	N/A	PM / UN	Extractive pit	E	HS2 LiDAR 2012	Group of four possible former quarry pits. Not recorded on historic OS maps. Underlying bedrock is chalk. Much smaller than other quarry pits in the vicinity so these may have been exploratory test pits.
I52 (CC031)	N/A	0830300000	PM / UN	Quarry	E	HS2 LiDAR 2012	A sizeable former chalk quarry pit is visible on LiDAR as an earthwork beneath an area of woodland. Indicated on modern and historic OS maps but not to its full extent. Associated spoil heaps not previously recorded. On Lewes Nodular Chalk Formation.
				Spoil heap / quarry	E	HS2 LiDAR 2012	Spoil heaps from chalk extraction are visible on LiDAR as earthworks beneath the trees on the edge of the wood. Quarry pit lies just to the NE. Pit indicated on historic OS maps but not to full extent, and spoil heaps not recorded.
I53	N/A	0830400000	PM / UN	Quarry	E	HS2 LiDAR 2012	Sizeable former quarry pit visible on LiDAR beneath trees. Indicated on modern and historic OS maps but not to full extent. Associated spoil heaps not previously recorded. On Lewes Nodular Chalk Formation, although 1st Edition OS map says 'Old Gravel Pit'.
				Spoil heap / quarry	E	HS2 LiDAR 2012	Spoil banked up around the edge of a former quarry pit is visible on LiDAR as earthworks beneath the trees of a small area of woodland. Not recorded on historic or modern OS maps though the pit itself is indicated.
I54	N/A	N/A	MD / PM	Field boundary / boundary bank	E	HS2 LiDAR 2012	A possible former field boundary bank is visible on LiDAR as an earthwork beneath the trees of Farthings Wood. Not recorded on historic OS maps.
I55	N/A	N/A	MD / PM	Field boundary / boundary bank	E	HS2 LiDAR 2012	A possible former field boundary bank is visible on LiDAR as an earthwork beneath the trees of Farthings Wood. Not recorded on historic OS maps. Very wide and diffuse appearance suggests it is almost levelled.
I56	N/A	N/A	MD / PM / UN	Trackway / boundary ditch	E	HS2 LiDAR 2012	A slightly sinuous linear ditch is visible on LiDAR as an earthwork beneath trees. Possibly a former trackway through the woodland although a more modern origin cannot be ruled-out. Not recorded on historic or modern OS maps.
I57	N/A	N/A	MD / PM	Field boundary / boundary bank	E	HS2 LiDAR 2012	A possible former field boundary bank is just visible on LiDAR as a faint linear earthwork. Several branching-off lengths visible. Diffuse appearance and considerable width likely due to centuries of plough-spread. Not recorded on historic OS maps.

Aerial Survey ID	NHL	HER	Period	Type	Evidence	Source	Description
I58	N/A	N/A	MD / PM	Field boundary / boundary bank	E	HS2 LiDAR 2012	Two parallel linear banks visible as faint earthworks on LiDAR. May be continuation of boundary bank to south (I57) but not clear why it would be split into two narrower parallel banks here.
I59	N/A	N/A	MD / PM	Ridge and furrow	E	HS2 LiDAR 2012	An area of possible ridge and furrow is just visible on LiDAR as almost completely ploughed-out earthworks.
I60	N/A	N/A	MD / PM	Field boundary / boundary bank	E	HS2 LiDAR 2012 / NMR SP9001-5 NMR 24877-33 12-December-2007	A former field boundary bank is visible on both LiDAR and aerial photographs as a rectilinear earthwork. Not recorded on historic OS maps. Appears to cut earlier ridge and furrow and associated boundary bank.
I61	N/A	N/A	PM / UN	Extractive pit / quarry	E	HS2 LiDAR 2012	A former quarry pit is clearly visible on LiDAR beneath trees. Underlying bedrock is chalk with superficial deposits of Clay-with-Flints. Not recorded on historic OS maps.
I62	N/A	N/A	C20 / WWII	Anderson shelter / air raid shelter / reservoir	E	HS2 LiDAR 2012 / HS2 Vertical Photography SP9100 2012	A sub-circular turf-covered mound and two adjoining rectangular turf-topped structures are visible on LiDAR and aerial photographs. Interpretation uncertain, but it is possible they may be something like an Anderson Shelter, although possibly too large.
					E / S	HS2 LiDAR 2012 / HS2 Vertical Photography SP9100 2012	A sub-circular turf-covered mound and two adjoining rectangular turf-topped structures are visible on LiDAR and aerial photographs. Interpretation uncertain, but it is possible they may be something like an Anderson Shelter, although possibly too large.
I63	N/A	N/A	PM / UN	Extractive pit / quarry	E	HS2 LiDAR 2012	A possible former quarry pit is visible as an earthwork on LiDAR. Not recorded on historic OS maps. Underlying bedrock in this area is chalk with an overlying superficial layer of clay-with-flints.
I64	N/A	N/A	MD / PM	Field boundary / boundary bank	E	NMR RAF-CPE-UK-1897 4053 12-December-1946 / HS2 LiDAR 2012	A probable former field boundary bank is visible on both vertical aerial photographs and LiDAR as a greatly plough-spread linear earthwork. Appears to be a continuation of the field boundary to the NW. Not recorded on historic OS maps.
I65	N/A	N/A	MD / PM	Ridge and furrow	E	HS2 LiDAR 2012	Possible ridge and furrow is faintly visible on LiDAR as slight earthworks within this field.
I66	N/A	N/A	MD / PM	Field boundary / boundary bank	E	HS2 LiDAR 2012	A group of possible former field boundaries is visible on LiDAR as linear earthworks. Not recorded on historic OS maps. Some may be 20th century paddock divisions rather than historic field boundaries.
				Field boundary / boundary ditch	E	HS2 LiDAR 2012	A group of possible former field boundaries is visible on LiDAR as linear earthworks. Not recorded on historic OS maps. Some may be 20 th century paddock divisions rather than historic field boundaries.
I67	N/A	N/A	PM / C20	Spoil heap	E	HS2 LiDAR 2012	Possible spoil heap from landscaping of gardens at Sheepcotts, or perhaps excavation of the swimming pool at The Hyde. One smooth circular mound with a more irregularly-shaped mound on its NW side.
I68	N/A	N/A	MD / PM	Ridge and furrow	E	HS2 LiDAR 2012	Ridge and furrow is visible on LiDAR as earthworks within this field. Likely to continue to the NE across the rest of the field but not mapped beyond the edge of the project boundary (and LiDAR coverage).
I69	N/A	N/A	MD / PM	Ridge and furrow	E	HS2 LiDAR 2012	A small area of possible ridge and furrow is visible on LiDAR as earthworks. They lie within what appears to be a formal garden, so it is possible the ridges may be the result of later landscaping; but may also be a fossilised fragment of past land use.
I70	N/A	N/A	MD / PM	Ridge and furrow	C	PGA SP9101 23-April-2010	Levelled ridge and furrow is visible as cropmarks on aerial photographs.
I71 (CCo32)	N/A	N/A	MD / PM	Plough headland / field boundary	E	HS2 LiDAR 2012	A possible former field boundary or plough headland is just visible on LiDAR as a degraded linear earthwork. Not recorded on historic OS maps.
				Ridge and furrow	E	HS2 LiDAR 2012	Possible ridge and furrow is just visible on LiDAR as highly-degraded earthworks. Field much-disturbed by later ploughing in different directions. Presence of several dolines (solution hollows) also confuses the picture.
							Ridge and furrow is visible on LiDAR as extant earthworks. Bisected by something like a modern service trench (NW to SE).
							Ridge and furrow is visible on LiDAR as extant earthworks. Cut at right-angles by more modern ploughing.
I72 (CCo32)	N/A	N/A	MD / PM	Field boundary / boundary bank	E	HS2 LiDAR 2012	A probable former field boundary bank is visible on LiDAR as a linear earthwork alongside a field of ridge and furrow. Kinks around a pond marked on the 1st Edition OS survey map approximately halfway along. Bank not recorded on historic OS maps.
							A probable former field boundary bank is visible on LiDAR as an extant linear earthwork alongside ridge and furrow. Not recorded on historic OS maps.
				Ridge and furrow	E	HS2 LiDAR 2012	A probable former plough headland or field boundary bank is visible on LiDAR as an extant linear earthwork at one end of a field of

Aerial Survey ID	NHL	HER	Period	Type	Evidence	Source	Description
							ridge and furrow. Not recorded on historic OS maps.
							Ridge and furrow is visible on LiDAR as extant earthworks.
							Ridge and furrow is visible on LiDAR as extant earthworks. Cut by a later boundary/drainage ditch.
						HS2 LiDAR 2012 / NMR SP9001-5 NMR 24877-33 12-December-2007	Ridge and furrow is visible on LiDAR as extant earthworks. Cut by a later field boundary ditch or drainage ditch.
							Ridge and furrow is visible on LiDAR as extant earthworks. Cut by a later field boundary ditch or drainage ditch.
173 (CCo32)	N/A	N/A	MD / PM	Ridge and furrow	E	HS2 LiDAR 2012	Possible ridge and furrow is visible on LiDAR as earthworks across this field. The image is confused by the presence of several dolines. Earthworks not well preserved.
174 (CCo32)	N/A	N/A	MD / PM	Ridge and furrow	E	HS2 LiDAR 2012	Possible ridge and furrow is visible on LiDAR as faint earthworks across the field to the north-east of Orchard Cottage.
175	N/A	N/A	MD / PM	Ridge and furrow	E	HS2 LiDAR 2012	Ridge and furrow is very faintly visible on LiDAR as earthworks.
176	N/A	N/A	MD / PM	Ridge and furrow	E	HS2 LiDAR 2012 / PGA SP9002 23-April-2010	Possible ridge and furrow is visible on LiDAR and aerial photographs as earthworks within this field. Cuts an earlier field boundary bank.
					E / LE	PGA SP9002 23-April-2010 / HS2 LiDAR 2012	Ridge and furrow which was just visible as earthworks on vertical aerial photographs of 2010 appear to have been levelled by the time of the 2012 LiDAR.
177 (CCo32)	N/A	N/A	MD / PM	Ridge and furrow	E	HS2 LiDAR 2012	Possible ridge and furrow is faintly visible on LiDAR as extant earthworks across this field.
							Possible ridge and furrow is just visible on LiDAR as extremely faintly extant earthworks. Appears to cut an earlier field boundary bank.
							Possible ridge and furrow is visible on LiDAR as faintly extant earthworks.
							Ridge and furrow is visible on LiDAR as earthworks across this field.
							Ridge and furrow is visible on LiDAR as earthworks across this field. Cut by what appear to be two later chalk pits.
178 (CCo32)	N/A	N/A	MD / PM	Ridge and furrow	E / LE	Cambridge University Collection of Aerial Photography RC8HD154 05-March-1985 / HS2 LiDAR 2012	Possible ridge and furrow visible on vertical aerial photographs of 1985 as slight earthworks appear to have been levelled by the time of the 2012 LiDAR.
					E	HS2 LiDAR 2012	Possible ridge and furrow is very faintly visible as earthworks across these two fields.
							Ridge and furrow is visible across this field as earthworks on LiDAR. Appears to go over the top of an earlier bank which is also still extant.
179	N/A	N/A	MD / PM	Ridge and furrow	E	HS2 LiDAR 2012	Possible ridge and furrow is visible on LiDAR as faintly extant earthworks across this field on the northern side of Leather Lane.
180	N/A	N/A	MD / PM	Ridge and furrow	E	HS2 LiDAR 2012	Possible ridge and furrow is visible on LiDAR as faintly extant earthworks across the eastern end of the Woodlands Park grounds. LiDAR shows the linear earthworks of the ridge and furrow continuing beyond the boundary to the north-east in the next CFA.
181	N/A	N/A	PM / UN	Spoil heap	E	HS2 LiDAR 2012	A small irregularly-shaped mound is visible as an earthwork on LiDAR. Possible spoil heap from nearby extractive activity such as maybe the quarry to the SW (153).
182 (DWH008) ¹⁹	1066073	0014010000	IA	Linear earthwork	E	HS2 LiDAR 2012	125m stretch of Grim's Ditch is visible on LiDAR as earthworks beneath trees. Cut by lane leading to Three Bears, which was the site of a former chalk pit. Bank on eastern side of southern section may be the result of the modern hedgerow boundary.

¹⁹ Discussed within the Dunsmore, Wendover and Halton study area (CFA10).

2.6 Results: interpretation

- 2.6.1 Eighty-two possible archaeological features were recorded from the remote sensed imagery that was surveyed as part of this project.
- 2.6.2 The features identified ranged in date from the Iron Age (I82; DWH008) to the 20th century (I62) and relate to a broad spectrum of activities such as agriculture, industry (quarrying) and defence (I21; CCo17) (see Table 4 for full details).
- 2.6.3 A short section of an Iron Age linear earthwork was visible on LiDAR as a substantial ditch and bank beneath trees to the north-east of Cottage Farm (feature I82, scheduled monument 1021198). This section is one of several referred to as Grim's Ditch. The stretch recorded here has been bisected by a trackway. The bank on the western side of the ditch appears to extend slightly beyond the scheduling polygon in places. It is possible this may be the result of confusion created by later field boundary banks adjoining the earlier earthwork. This feature continues north-eastwards into the Dunsmore, Wendover and Halton study area (CFA10), where it is recorded as Jo3 (DWH008).
- 2.6.4 Several sections of a medieval moated site (I24; CCo66) are visible as earthworks on LiDAR at Bury Farm, on the north-western edge of South Heath. Eastern parts of the moat recorded on the 1st Edition OS map are now no longer extant apparently due to development and landscaping at the farm. As those sections that can be seen on the LiDAR differ slightly from what is indicated on the modern OS map they have been transcribed for this project.
- 2.6.5 A medieval motte and bailey site (I21; CCo17) is visible on LiDAR as earthworks in a field on the south-western side of Hyde Heath. The motte mound and outer bailey bank are clearly visible as earthworks although the NHL and HER records for the site state it is almost ploughed-out. This site is a scheduled monument (1009534) known as Castle Tower. All the features transcribed here fell within the scheduling polygon.
- 2.6.6 The survey recorded numerous areas of extant and flattened ridge and furrow dating to the medieval or early post-medieval periods. It was nowhere near as densely apparent, however, as for some of the more northerly study areas (such as the Waddesdon and Quainton study area (CFA12)).
- 2.6.7 The survey also recorded the earthwork remains of a number of former field boundaries and possible plough headlands. Most of these are likely to be medieval or post-medieval in date. As noted in Section 2.2 former field boundaries already recorded on historic OS maps were not transcribed here.
- 2.6.8 The high resolution of the LiDAR imagery revealed the prolific occurrence of dolines, or solution holes/hollows, across the landscape. Dolines are common on chalk bedrocks,^{20,21} such as that of the survey area.²² Dolines can appear similar to the remains of former quarrying activity, but in this instance the overwhelming frequency of their occurrence indicated that these features were likely to be of natural origin.

- 2.6.9 The survey also recorded what appeared to be genuine evidence of past extractive industry (features I44 (CCo81), I31-I43 (CCo19)). These extractive features were jagged and irregularly shaped and sometimes had accompanying spoil heaps, differentiating them from the smooth circular or oval dolines. It is not unknown for dolines to be worked as chalk pits,²³ and it is possible that this may have been the origin of some of the former quarries mapped here.
- 2.6.10 A possible post-medieval or 20th century firing range including a possible rifle butt structure (Io8; CCo08) is visible on LiDAR as earthworks beneath the trees of Lott's Wood. This feature was not recorded on any of the historic OS maps consulted as part of this survey.

2.7 Conclusions

- 2.7.1 Eighty-two individual or grouped possible archaeological features were identified by the survey, 67 of which are not recorded by either the HER or NHL data. These features include:
- a section of the Iron Age linear earthwork known as Grim's Ditch (scheduled monument 1021198);
 - earthwork remains of several sections of a medieval moat at Bury Farm;
 - earthwork remains of a medieval motte and bailey at Hyde Heath (scheduled monument 1009534);
 - numerous areas of extant and flattened ridge and furrow;
 - medieval and post-medieval field boundary earthworks;
 - numerous areas of probably post-medieval quarrying; and
 - earthwork remains of the rifle butts of a post-medieval or 20th century firing range.

2.8 References

- Blom, (2012), *HS2 Hyperspectral Information*, BLOM Project Number: 03/037/12.
- British Geological Survey (BGS), (2012), *Digital Geological Map of Great Britain (DiGMapGB-10) at 1:10 000 scale, for bedrock geology and superficial deposits*, Digital Data Licence No. 2012/062.
- English Heritage, NMR Monument Type Thesaurus; http://thesaurus.english-heritage.org.uk/thesaurus.asp?thes_no=1; Accessed: August 2012 - June 2013.
- Fenner, V.E.P., (1992), *Crop Marks in Hertfordshire: a report for the National Mapping Programme*, RCHME internal document.
- Fenner, V.E.P., (1994), *The Thames Valley Project: a report for the National Mapping Programme*, RCHME Aerial Survey Report Series.
- GeoStore; Aerial Photography RGB Product; <http://www.geostore.com/geostore4/WebStore?xml=geostore4/xml/productsAPRGB.xml>; Accessed: August 2013.

²⁰ Wilson, D., (2000) *Air Photo Interpretation for Archaeologists*, Tempus Publishing Ltd, Stroud, P168-9.

²¹ Natural Environment Research Council (NERC), (2006), *Geology of the Salisbury Sheet Area*, British Geological Society, Onshore Geology Series, Internal Report IR/06/011, P212.

²² British Geological Survey, (2012), *Digital Geological Map of Great Britain (DiGMapGB-10) at 1:10 000 scale, for bedrock geology and superficial deposits*, Digital Data Licence No. 2012/062.

²³ NERC, (2006) P215.

Natural Environment Research Council (NERC), (2006), *Geology of the Salisbury Sheet Area*, British Geological Society, Onshore Geology Series, Internal Report IR/06/011.

Ordnance Survey; Products and Services FAQs: How accurate are your products?; <http://www.ordnancesurvey.co.uk/oswebsite/support/products-services.html>; Accessed: June 2013.

Powlesland, D., Lyall, J. and Donoghue, D., (1997), Enhancing the record through remote sensing: the application and integration of multi-sensor, non-invasive remote sensing techniques for the enhancement of the Sites and Monuments Record, Heslerton Parish Project, N. Yorkshire, England, *Internet Archaeology* 2; <http://dx.doi.org/10.11141/ia.2.4>; Accessed: 18 December 2012.

Wilson, D., (2000), *Air Photo Interpretation for Archaeologists*, Tempus Publishing Ltd, Stroud.

Winton, H., (2012), Standards for National Mapping Programme projects, Version 0.1 Draft, English Heritage, Aerial Investigation and Mapping, Typescript document.

2.9 Historic aerial photographs consulted

Table 5: English Heritage vertical aerial photographs consulted for the remote sensing survey of CFAg

English Heritage library number	Original sortie number	Original frame number	Date taken
559	RAF/CPE/UK/1936	4010	18 January 1947
559	RAF/CPE/UK/1936	4011	18 January 1947
559	RAF/CPE/UK/1936	4012	18 January 1947
559	RAF/CPE/UK/1936	4013	18 January 1947
559	RAF/CPE/UK/1936	4014	18 January 1947
562	RAF/CPE/UK/1897	3004	12 December 1946
562	RAF/CPE/UK/1897	3005	12 December 1946
562	RAF/CPE/UK/1897	3006	12 December 1946
562	RAF/CPE/UK/1897	3051	12 December 1946
562	RAF/CPE/UK/1897	3052	12 December 1946
562	RAF/CPE/UK/1897	4006	12 December 1946
562	RAF/CPE/UK/1897	4007	12 December 1946
562	RAF/CPE/UK/1897	4008	12 December 1946
562	RAF/CPE/UK/1897	4053	12 December 1946
562	RAF/CPE/UK/1897	4054	12 December 1946
795	RAF/CPE/UK/2483	3296	10 March 1948
795	RAF/CPE/UK/2483	3297	10 March 1948

English Heritage library number	Original sortie number	Original frame number	Date taken
795	RAF/CPE/UK/2483	3298	10 March 1948
795	RAF/CPE/UK/2483	3299	10 March 1948
795	RAF/CPE/UK/2483	3306	10 March 1948
795	RAF/CPE/UK/2483	3307	10 March 1948
795	RAF/CPE/UK/2483	3308	10 March 1948
795	RAF/CPE/UK/2483	3309	10 March 1948
795	RAF/CPE/UK/2483	3342	10 March 1948
795	RAF/CPE/UK/2483	3343	10 March 1948
795	RAF/CPE/UK/2483	3344	10 March 1948
915	RAF/541/107	3139	26 July 1948
915	RAF/541/107	3140	26 July 1948
1061	RAF/541/479	4370	07 April 1950
1061	RAF/541/479	4371	07 April 1950
1061	RAF/541/479	4372	07 April 1950
1160	RAF/58/651	3016	24 April 1951
1160	RAF/58/651	3017	24 April 1951
1160	RAF/58/651	3018	24 April 1951
1160	RAF/58/651	3019	24 April 1951
1160	RAF/58/651	4014	24 April 1951
1160	RAF/58/651	4015	24 April 1951
1160	RAF/58/651	4016	24 April 1951
1160	RAF/58/651	4017	24 April 1951
1171	RAF/58/649	3022	23 April 1951
1171	RAF/58/649	3023	23 April 1951
1171	RAF/58/649	3024	23 April 1951
1171	RAF/58/649	3025	23 April 1951
1171	RAF/58/649	3026	23 April 1951
1171	RAF/58/649	3027	23 April 1951
1171	RAF/58/649	4019	23 April 1951
1171	RAF/58/649	4020	23 April 1951
1171	RAF/58/649	4021	23 April 1951
1171	RAF/58/649	4022	23 April 1951

English Heritage library number	Original sortie number	Original frame number	Date taken
1171	RAF/58/649	4023	23 April 1951
1171	RAF/58/649	4033	23 April 1951
1171	RAF/58/649	4034	23 April 1951
1171	RAF/58/649	4035	23 April 1951
1522	RAF/82/895	355	08 April 1954
1522	RAF/82/895	356	08 April 1954
1522	RAF/82/895	357	08 April 1954
1522	RAF/82/895	358	08 April 1954
1548	RAF/58/1472	200	24 June 1954
1548	RAF/58/1472	201	24 June 1954
1548	RAF/58/1472	202	24 June 1954
1548	RAF/58/1472	203	24 June 1954
1548	RAF/58/1472	204	24 June 1954
1548	RAF/58/1472	205	24 June 1954
1548	RAF/58/1472	279	24 June 1954
2143	RAF/58/4662	112	01 September 1961
2143	RAF/58/4662	113	01 September 1961
2143	RAF/58/4662	114	01 September 1961
2143	RAF/58/4662	115	01 September 1961
2195	RAF/58/4627	463	16 August 1961
2195	RAF/58/4627	464	16 August 1961
2195	RAF/58/4627	465	16 August 1961
2213	RAF/543/1426	47	28 August 1961
2213	RAF/543/1426	48	28 August 1961
2213	RAF/543/1426	49	28 August 1961
2213	RAF/543/1426	50	28 August 1961
2213	RAF/543/1426	51	28 August 1961
2213	RAF/543/1426	52	28 August 1961
3555	RAF/106G/UK/686	3227	23 August 1945
10451	OS/72145	22	23 May 1972
10451	OS/72145	23	23 May 1972
10451	OS/72145	43	23 May 1972

English Heritage library number	Original sortie number	Original frame number	Date taken
10451	OS/72145	44	23 May 1972
10451	OS/72145	45	23 May 1972
10451	OS/72145	54	23 May 1972
10451	OS/72145	55	23 May 1972
10451	OS/72145	56	23 May 1972
10451	OS/72145	119	23 May 1972
10451	OS/72145	120	23 May 1972
10451	OS/72145	121	23 May 1972
10452	OS/73056	446	31 March 1973
10452	OS/73056	447	31 March 1973
11638	OS/69254	212	10 June 1969
11639	OS/69255	252	10 June 1969
11639	OS/69255	253	10 June 1969
11639	OS/69255	254	10 June 1969
11639	OS/69255	258	10 June 1969
11639	OS/69255	259	10 June 1969
11639	OS/69255	295	10 June 1969
11639	OS/69255	296	10 June 1969
13650	OS/90024	53	18 March 1990
13650	OS/90024	88	18 March 1990
13650	OS/90024	89	18 March 1990
14767	OS/94535	17	18 October 1994
14767	OS/94535	18	18 October 1994
14767	OS/94535	19	18 October 1994
14767	OS/94535	20	18 October 1994
14767	OS/94535	47	18 October 1994
14767	OS/94535	48	18 October 1994
14767	OS/94535	49	18 October 1994
14767	OS/94535	50	18 October 1994
14767	OS/94535	81	18 October 1994
14767	OS/94535	82	18 October 1994
14767	OS/94535	83	18 October 1994

Table 6: English Heritage oblique aerial photographs consulted for the remote sensing survey of CFA9

English Heritage photo reference	Film number	Original frame number	Date taken
SP 8803/ 1	NMR 26962	/ 27	01 June 2011
SP 8901/ 7	NMR 24877	/ 41	12 December2007
SP 8901/ 8	NMR 24877	/ 42	12 December2007
SP 8903/ 1	NMR 24564	/ 16	16 March 2007
SP 8903/ 2	NMR 24564	/ 17	16 March 2007
SP 8903/ 3	NMR 24564	/ 18	16 March 2007
SP 8903/ 4	NMR 24564	/ 19	16 March 2007
SP 8903/ 5	NMR 24564	/ 20	16 March 2007
SP 8903/ 6	NMR 24564	/ 21	16 March 2007
SP 8903/ 7	NMR 24564	/ 22	16 March 2007
SP 8903/ 8	NMR 24564	/ 23	16 March 2007
SP 8903/ 9	NMR 26962	/ 22	01 June 2011
SP 8903/ 10	NMR 26962	/ 23	01 June 2011
SP 8903/ 11	NMR 26962	/ 24	01 June 2011
SP 8903/ 12	NMR 26962	/ 25	01 June 2011
SP 8903/ 13	NMR 26962	/ 26	01 June 2011
SP 8903/ 14	NMR 26962	/ 28	01 June 2011
SP 9000 / 1	NMR 18817	/ 31	17 August 2000
SP 9000 / 2	NMR 18817	/ 32	17 August 2000
SP 9000 / 3	NMR 18817	/ 33	17 August 2000
SP 9000 / 5	NMR 18817	/ 37	17 August 2000
SP 9000 / 6	NMR 18911	/ 17	17 August 2000
SP 9000 / 11	NMR 24878	/ 16	12 December 2007
SP 9000 / 12	NMR 24878	/ 17	12 December 2007
SP 9000 / 13	NMR 24878	/ 18	12 December 2007
SP 9000 / 14	NMR 24878	/ 19	12 December 2007
SP 9000 / 15	NMR 24878	/ 20	12 December 2007
SP 9000 / 16	NMR 24878	/ 21	12 December 2007
SP 9001/ 1	NMR 18817	/ 35	17 August 2000
SP 9001/ 2	NMR 18911	/ 16	17 August 2000

English Heritage photo reference	Film number	Original frame number	Date taken
SP 9001/ 3	NMR 18911	/ 18	17 August 2000
SP 9001/ 4	NMR 24877	/ 32	12 December2007
SP 9001/ 5	NMR 24877	/ 33	12 December2007
SP 9001/ 6	NMR 24877	/ 34	12 December2007
SP 9001/ 7	NMR 24877	/ 35	12 December2007
SP 9001/ 8	NMR 24877	/ 36	12 December2007
SP 9001/ 9	NMR 24877	/ 37	12 December2007
SP 9001/ 10	NMR 24877	/ 38	12 December2007
SP 9001/ 11	NMR 24877	/ 39	12 December2007
SP 9001/ 12	NMR 24877	/ 40	12 December2007
SP 9001/ 13	NMR 24878	/ 14	12 December2007
SP 9001/ 14	AFL 60768	/ EPW036325	August 1931
SP 9001/ 15	AFL 60768	/ EPW036328	August 1931
SP 9100 / 1	NMR 26962	/ 29	01 June 2011
SP 9102 / 1	NMR 24877	/ 28	12 December 2007
SP 9102 / 2	NMR 24877	/ 29	12 December 2007
SP 9102 / 3	NMR 24877	/ 30	12 December 2007
SP 9102 / 4	NMR 24877	/ 31	12 December 2007
SU 9199 / 1	NMR 26962	/ 30	01 June 2011
SU 9299 / 1	NMR 24878	/ 22	12 December 2007
SU 9299 / 2	NMR 24878	/ 23	12 December 2007
SU 9299 / 3	NMR 24878	/ 24	12 December 2007
SU 9299 / 4	NMR 24878	/ 25	12 December 2007
SU 9299 / 5	NMR 24878	/ 26	12 December 2007
SU 9299 / 6	NMR 24878	/ 27	12 December 2007
SU 9299 / 7	NMR 24878	/ 28	12 December 2007
SU 9299 / 8	NMR 24878	/ 29	12 December 2007
SU 9299 / 9	NMR 24878	/ 30	12 December 2007
SU 9299 / 10	NMR 24878	/ 31	12 December 2007
SU 9299 / 11	NMR 24878	/ 32	12 December 2007
SU 9299 / 12	NMR 26962	/ 35	01 June 2011
SU 9299 / 13	NMR 26962	/ 31	01 June 2011

English Heritage photo reference	Film number	Original frame number	Date taken
SU 9299 / 14	NMR 26962	/ 32	01 June 2011
SU 9299 / 15	NMR 26962	/ 33	01 June 2011
SU 9299 / 16	NMR 26962	/ 34	01 June 2011
SU 9397 / 2	NMR 18940	/ 16	22 September 2000
SU 9397 / 22	AFL 60855	/ EPW044263	May 1934
SU 9398 / 1	NMR 18940	/ 22	22 SEP 2000
SU 9398 / 2	NMR 18940	/ 23	22 September 2000
SU 9398 / 3	NMR 18877	/ 30	22 September 2000
SU 9398 / 4	NMR 26962	/ 36	01 June 2011
SU 9398 / 6	NMR 26962	/ 38	01 June 2011

Table 7: Cambridge University Collection of Aerial Photography aerial photographs consulted for the remote sensing survey of CFAg

Cambridge University Collection of Aerial Photography catalogue number	Date taken	Type
70kAJ12	05/07/1982	Oblique
70kAJ13	05/07/1982	Oblique
70kAJ14	05/07/1982	Oblique
70kAJ15	05/07/1982	Oblique
RC8HD154	05/03/1985	Vertical
RC8HD155	05/03/1985	Vertical
RC8HD156	05/03/1985	Vertical
RC8HG185	06/03/1985	Vertical
RC8HG186	06/03/1985	Vertical
RC8HG232	06/03/1985	Vertical
RC8HG233	06/03/1985	Vertical
RC8HG234	06/03/1985	Vertical

2.10 Figures

- CH004.09.01 Remote sensing survey interpretation 1:5,000
- CH004.09.02 Remote sensing survey interpretation 1:5,000
- CH004.09.03 Remote sensing survey interpretation 1:5,000
- CH004.09.04 Remote sensing survey interpretation 1:5,000
- CH004.09.05 Remote sensing survey interpretation 1:5,000

3 Geophysical surveys

3.1 Site MVoAB: Mantles Wood (CCo19)

Introduction

- 3.1.1 A geophysical survey was conducted over a predefined area on land on the west side of Mantles Wood, Hyde Heath Road, Buckinghamshire (CCo19; national grid reference: SU 91786 99575; Figure CH004.09.06). The aim of the survey was to locate and characterise any anomalies of possible archaeological interest within the survey site.

The site

- 3.1.2 The survey site lies to the north of the A413 approximately 1.5km south-west of the village of Hyde Heath. The survey area was located within a single field and measured approximately 2ha. The survey was carried out on the 30 May 2013. The site was under a short crop during the fieldwork.
- 3.1.3 The site is situated on bedrock of the Lewes Nodular Chalk Formation and Seaford Chalk Formation (undifferentiated). The superficial deposits consist of Clay-With-Flints Formation.²⁴ The soils in the area are Batcombe-type, which are typical stagnogleyic argillic brown earth soils. These consist of fine silty over clayey and fine loamy over clayey soils with slowly permeable subsoils and slight seasonal waterlogging.²⁵

Summary archaeological/historic background

- 3.1.4 The following information is summarised from the records of the Buckinghamshire County (HER).
- 3.1.5 A previous fieldwalking survey in the area of the site recovered prehistoric, Roman, medieval and early medieval artefacts. The site has a high potential for below-ground archaeological remains from these eras.

Methodology

- 3.1.6 The survey was carried out in line with current English Heritage guidelines²⁶ and a written scheme of investigation.²⁷ All survey grid positioning was carried out using Trimble R8 Real Time Kinematic VRSNow equipment. The geophysical survey area was georeferenced relative to the Ordnance Survey National Grid by tying in to local detail and corrected to the mapping provided by the client. These tie-ins are presented in Figure CH004.09.07. Please refer to this diagram when re-establishing the grid or positioning trenches.

- 3.1.7 The magnetometer survey was carried out with Bartington Grad 601-2 fluxgate gradiometers, collecting data every 0.25m along traverses 1m apart. Data processing has been performed as appropriate using an in-house software package employing the following processing steps: Destripe (removes striping effects caused by zero point discrepancies between different sensors and walking directions) and Destagger (removes zig-zag effects caused by inconsistent walking speeds on sloping, uneven or overgrown terrain).

- 3.1.8 The presentation of the data for each site includes a print-out of the minimally processed data both as a greyscale plot and as a colour plot showing extreme magnetic values (Figures CH004.09.08 and CH004.09.09).

Limitations

- 3.1.9 Magnetic survey is an exceedingly effective technique for site evaluation providing fast data acquisition and responding, to some degree, to the majority of archaeological site-types. The technique relies upon anthropogenic enhancement of naturally-occurring iron-bearing compounds in the soil. Detection rates can be poor where archaeological sites have seen only temporary and/or sporadic occupation or where there is insufficient activity to drive the enhancement (this is often true of lithic-era sites). Success may also be limited over soils that are deficient in iron compounds providing little material to be subject to enhancement. Conversely, the strength of response from soils and geological units which are naturally magnetic (for example igneous formations and soils derived thereof) may mask any subtler archaeological enhancement within.
- 3.1.10 The presence of ferrous structures either above or below ground (buildings, pylons, fences, pipes, etc.) will produce very strong magnetic fields which will extend far beyond their physical footprint. The strength of these magnetic 'shadows' is such that they may mask practically any adjacent archaeological anomalies. Similarly later features and demolition spreads or imported consolidation material can produce areas of magnetic disturbance that will mask underlying features.
- 3.1.11 As a general rule, the Bartington Grad601 instruments allow for a depth of investigation of approximately 1m, depending on the strength of the field produced by the buried feature. Below this depth only particularly enhanced material will be detected with any degree of confidence.
- 3.1.12 The general conditions for the surveyed field were good with only a short crop in-situ during the fieldwork.

Assumptions

- 3.1.13 All of the fields contain small-scale ferrous anomalies most clearly represented by sharp 'spikes' in the colour plots. These are typically assumed to be modern debris within the topsoil unless the site type or prior knowledge suggests otherwise.

²⁴ British Geological Survey, Geology of Britain Viewer; <http://www.bgs.ac.uk/opengeoscience/home.html?Accordion1=1#maps>; Accessed: June 2013.

²⁵ Soil Survey of England and Wales, (1983), *Soils of England and Wales, Sheet 6: South East England*.

²⁶ English Heritage, (2008), *Geophysical Survey in Archaeological Field Evaluation*, English Heritage, Portsmouth.

²⁷ Cotswold Archaeology, (2013), *HS2 Buckinghamshire: Written Scheme of Investigation for Geophysical and Metal Detecting Surveys*.

Results: description

- 3.1.14 The gradiometer data is dominated by a region of amorphous magnetic variation seen predominantly in the central portion of the site (see Figure CH004.09.10).
- 3.1.15 Three discrete positive anomalies identified in the north-eastern part of the site are possibly indicative of former cut features such as pits although they may also be of natural origin.
- 3.1.16 Several areas of parallel linear anomalies identified in the northern part of the survey area are indicative of agricultural activity.
- 3.1.17 A region of high strength responses is seen adjacent to the field boundary in the southern part of the site and a further high amplitude response is noted in the south-eastern part of the site. These anomalies are associated with ferrous materials and magnetic disturbance. Also noted are several magnetic 'spikes'.

Results: interpretation

- 3.1.18 Three discrete positive responses noted in the north-eastern part of the site may indicate in-filled pits of possible archaeological interest although these responses may also be of natural origin (see Figure CH004.09.10).
- 3.1.19 The parallel linear responses seen in the northern part of the site are indicative of agricultural activity, and the close spacing of the responses is suggestive of a modern origin. The amorphous magnetic variation observed within this area of the site is indicative of a natural response associated with variations within the geology or pedology of the site.

Conclusions

- 3.1.20 The geophysical survey identified three discrete anomalies. These may relate to pits of unknown date, but they may also be natural in origin.

3.2 References

- 3.2.1 British Geological Survey, Geology of Britain Viewer;
<http://www.bgs.ac.uk/opengeoscience/home.html?Accordion1=1#maps> ; Accessed: June 2013.

 Cotswold Archaeology, (2013), *HS2 Buckinghamshire: Written Scheme of Investigation for Geophysical and Metal Detecting Surveys*.

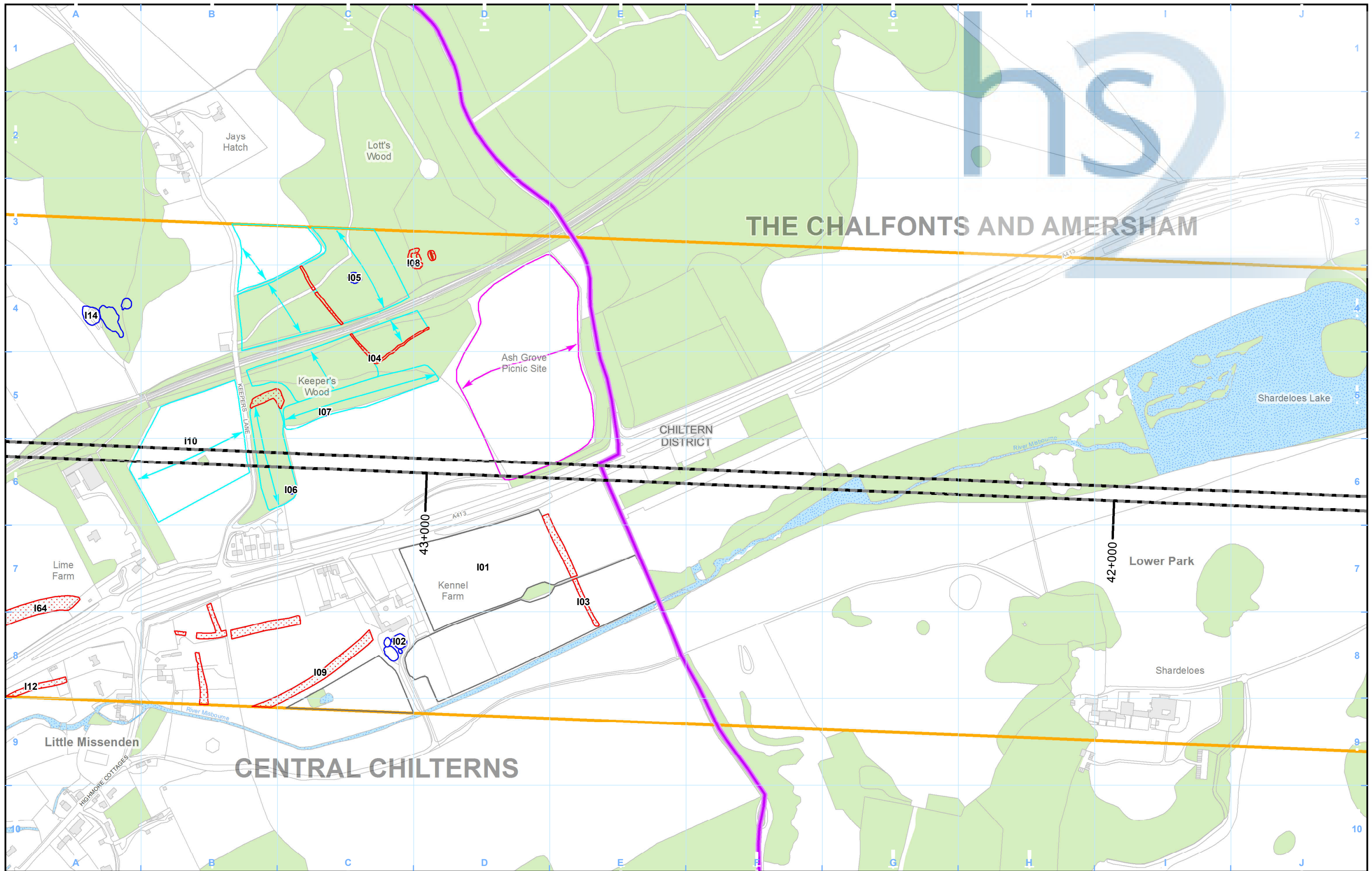
 English Heritage, (2008), *Geophysical Survey in Archaeological Field Evaluation*, English Heritage, Portsmouth.

 Soil Survey of England and Wales, (1983), *Soils of England and Wales, Sheet 6: South East England*.

3.3 Figures

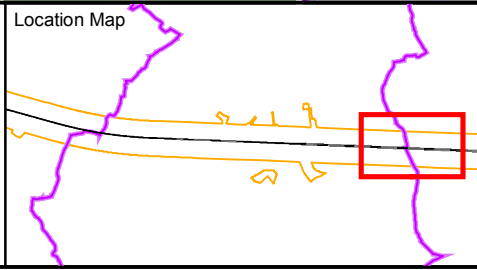
- CH004.09.06 Location plan of survey area 1:25000

- CH004.09.07 Location of survey grids and referencing 1:1000
- CH004.09.08 Colour plot of gradiometer data 1:1000
- CH004.09.09 Plot of minimally processed gradiometer data 1:1000
- CH004.09.10 Abstraction and interpretation of gradiometer anomalies 1:1000



Legend

Route in tunnel	Remote sensing survey boundary	Archaeological features	Extent of Area
Route on surface		Bank	Bank
Community forum boundary		Ditch	Ditch
District/Borough boundary		Extant ridge and furrow direction	Extant ridge and furrow outline
Watercourse		Levelled ridge and furrow direction	Levelled ridge and furrow outline
Water body		Structure	Structure
Woodland		T-Hachure	Large cut feature



Map Number	CH-004-09.01
Map Name	Remote Sensing Survey Interpretation
Community Forum Area CFA9: Central Chilterns	

ETM accept no responsibility for any circumstances, which arise from the reproduction of this map after alteration, amendment or abbreviation or if it is issued in part or issued incomplete in any way.

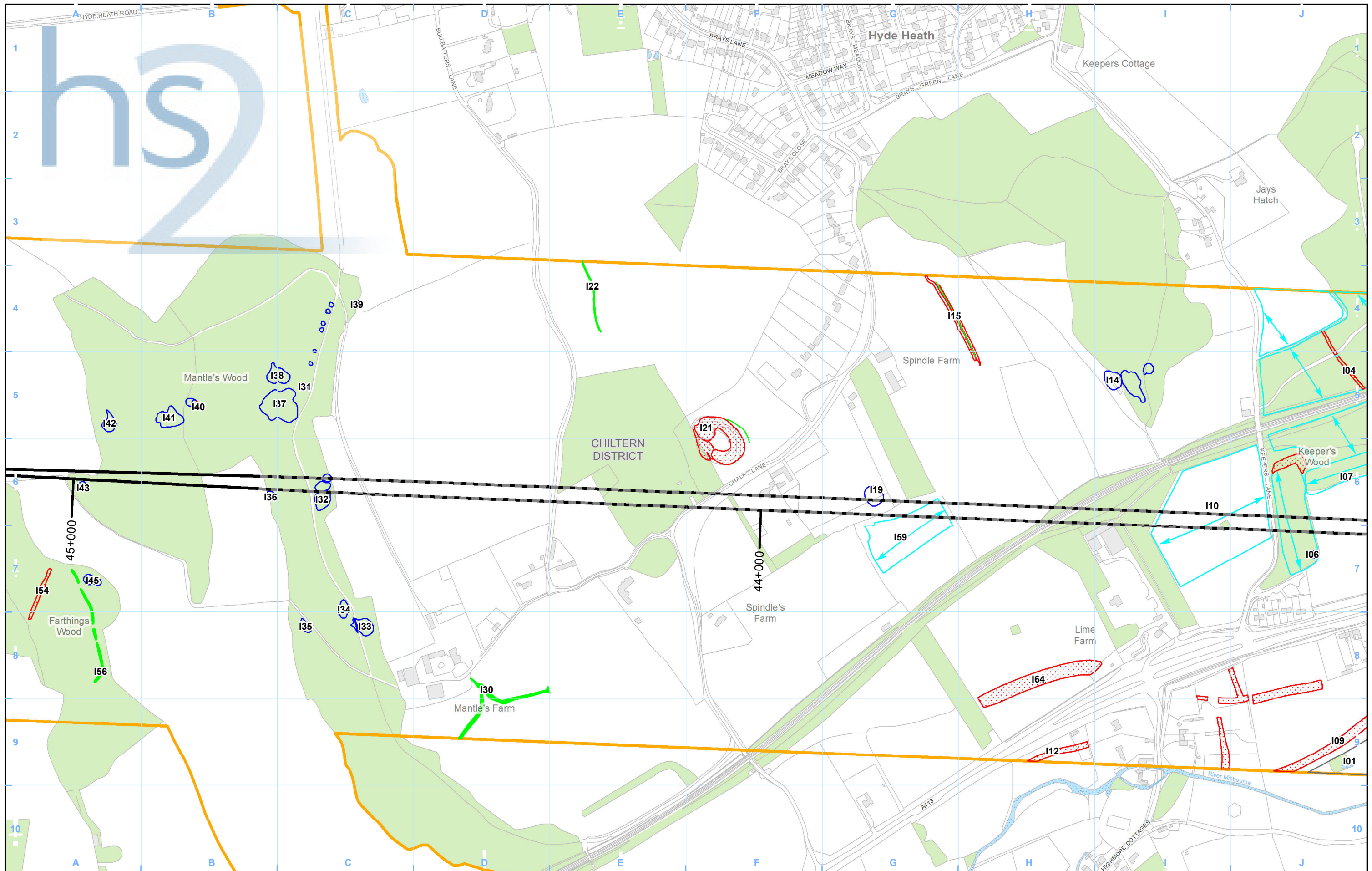
Scale at A3: 1:5,000

© Crown copyright and database rights 2013.
Ordnance Survey Licence Number 100049190.

Doc Number: C252-ETM-EV-MAP-020-002566-P03.00

Date: 06/09/13





Legend

Route in tunnel	Remote sensing survey boundary	Archaeological features	Extent of Area
Route on surface		Bank	Bank
Community forum boundary		Ditch	Ditch
District/Borough boundary		Extant ridge and furrow direction	Extant ridge and furrow outline
Watercourse		Levelled ridge and furrow direction	Levelled ridge and furrow outline
Water body		Structure	Structure
Woodland		T-Hachure	Large cut feature

Location Map

Map Number: CH-004-09.02

Map Name: Remote Sensing Survey Interpretation

Community Forum Area CFA9: Central Chilterns

ETM accept no responsibility for any circumstances, which arise from the reproduction of this map after alteration, amendment or abbreviation or if it is issued in part or issued incomplete in any way.

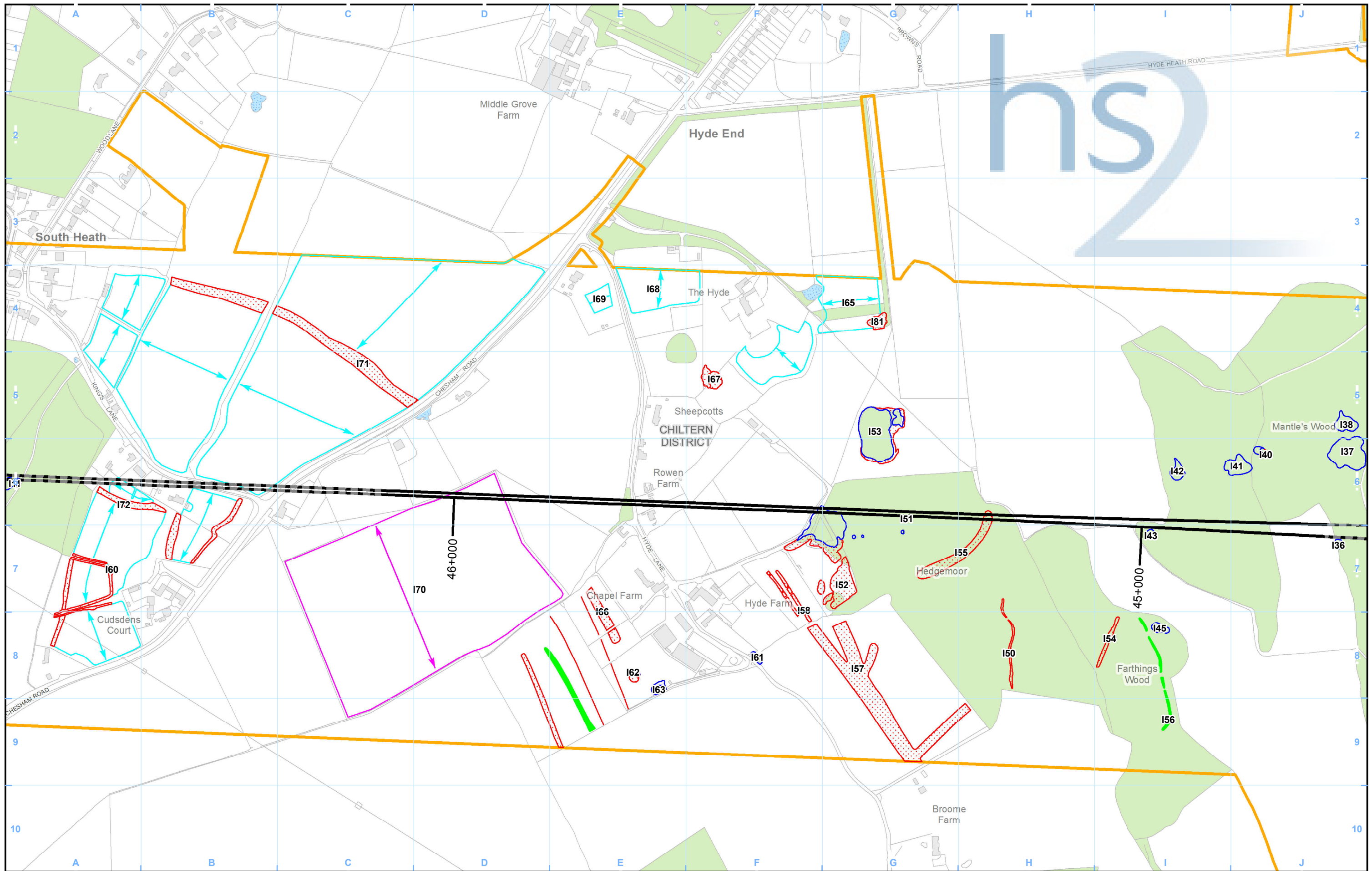
Scale at A3: 1:5,000

0 50 100 150 200 Metres

© Crown copyright and database rights 2013. Ordnance Survey Licence Number 100049190.

Doc Number: C252-ETM-EV-MAP-020-002567-P03.00

Date: 06/09/13



Legend

Route in tunnel

Route on surface

Community forum boundary

District/Borough boundary

Watercourse

Water body

Woodland

Remote sensing survey boundary

Bank

Ditch

Extant ridge and furrow direction

Levelled ridge and furrow direction

Structure

T-Hachure

Extent of Area

Bank

Ditch

Extant ridge and furrow outline

Levelled ridge and furrow outline

Structure

Large cut feature

Location Map

Map Number

CH-004-09.03

Map Name

Remote Sensing Survey Interpretation

Community Forum Area CFA9:
Central Chilterns

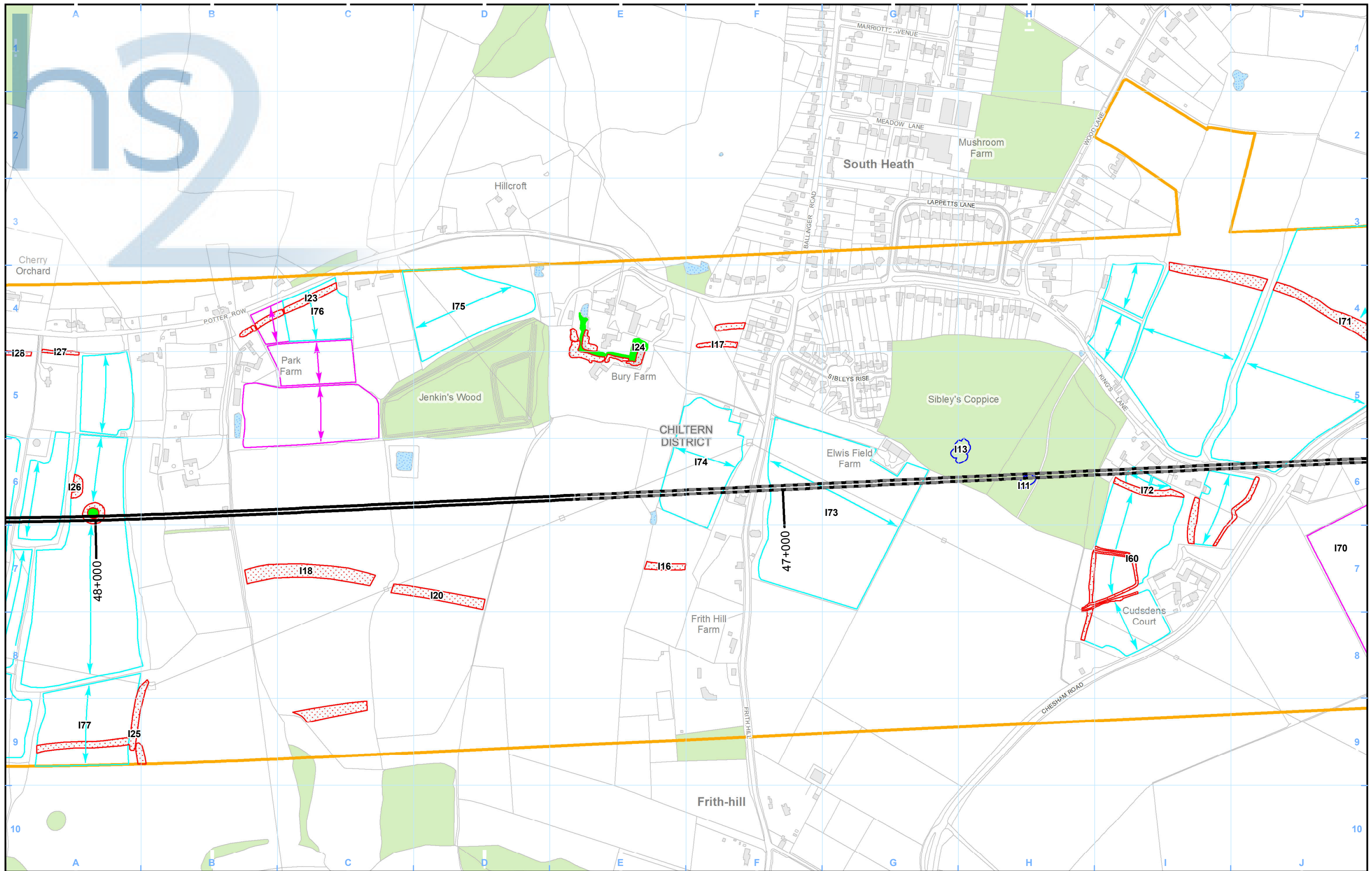
ETM accept no responsibility for any circumstances, which arise from the reproduction of this map after alteration, amendment or abbreviation or if it is issued in part or issued incomplete in any way.

Scale at A3: 1:5,000

© Crown copyright and database rights 2013.
Ordnance Survey Licence Number 100049190.

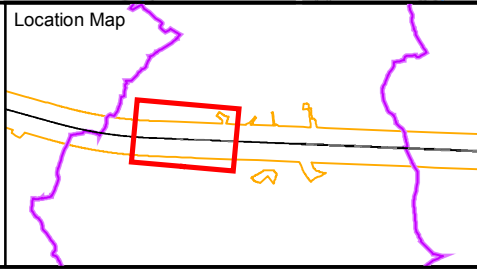
Doc Number: C252-ETM-EV-MAP-020-002568-P03.00

Date: 06/09/13



Legend

Route in tunnel	Remote sensing survey boundary	Archaeological features	Extent of Area
Route on surface		Bank	Bank
Community forum boundary		Ditch	Ditch
District/Borough boundary		Extant ridge and furrow direction	Extant ridge and furrow outline
Watercourse		Levelled ridge and furrow direction	Levelled ridge and furrow outline
Water body		Structure	Structure
Woodland		T-Hachure	Large cut feature



Map Number: CH-004-09.04

Map Name: Remote Sensing Survey Interpretation

Community Forum Area CFA9: Central Chilterns

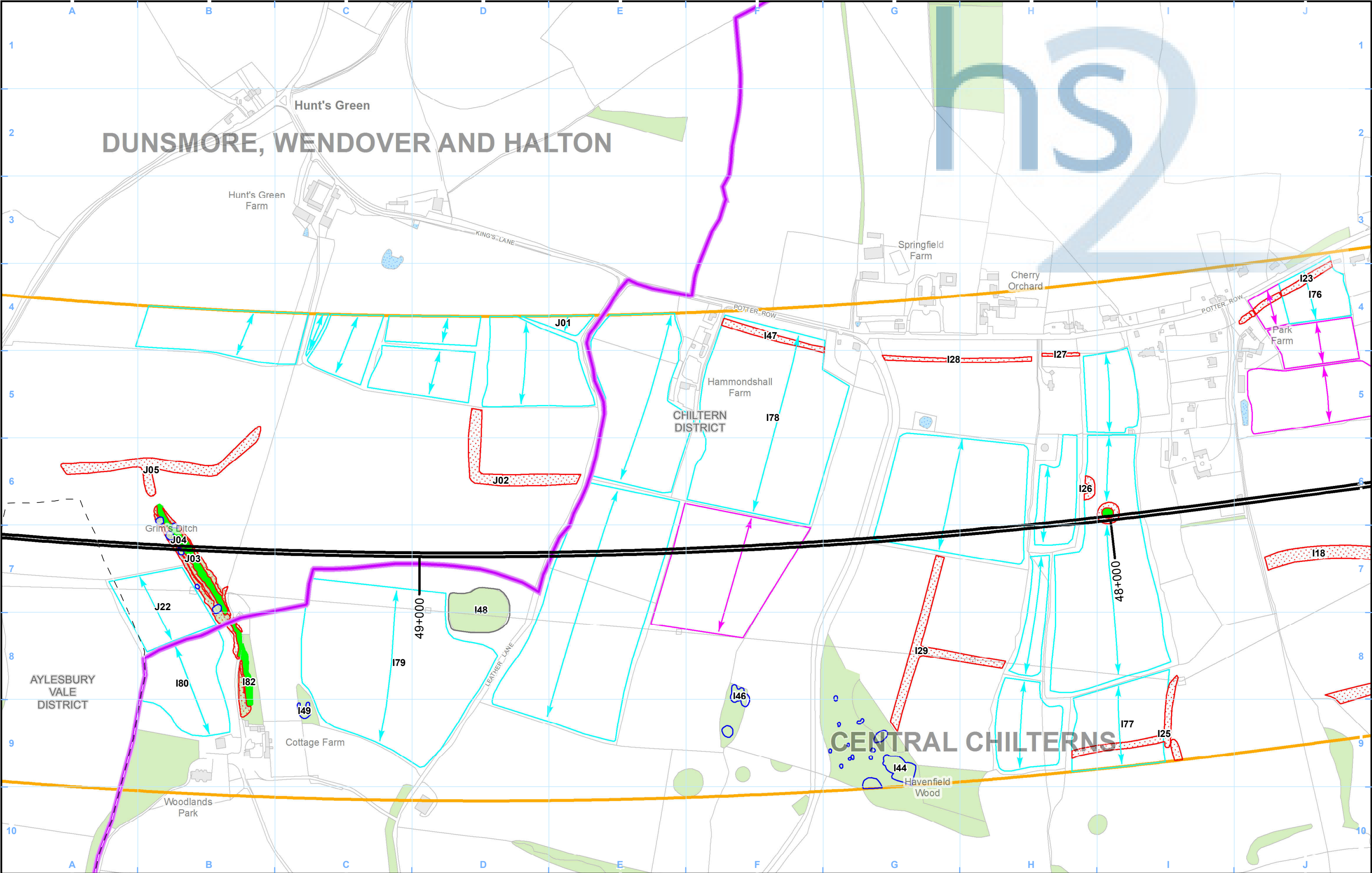
ETM accept no responsibility for any circumstances, which arise from the reproduction of this map after alteration, amendment or abbreviation or if it is issued in part or issued incomplete in any way.

Scale at A3: 1:5,000

© Crown copyright and database rights 2013. Ordnance Survey Licence Number 100049190.

Doc Number: C252-ETM-EV-MAP-020-002569-P03.00

Date: 06/09/13



Legend

Route in tunnel

Route on surface

Community forum boundary

District/Borough boundary

Watercourse

Water body

Woodland

Remote sensing survey boundary

Archaeological features

Bank

Ditch

Extant ridge and furrow direction

Levelled ridge and furrow direction

Structure

T-Hachure

Extent of Area

Bank

Ditch

Extant ridge and furrow outline

Levelled ridge and furrow outline

Structure

Large cut feature

Map Number

CH-004-09.05

Map Name

Remote Sensing Survey Interpretation

Community Forum Area CFA9:

Central Chilterns

ETM accept no responsibility for any circumstances, which arise from the reproduction of this map after alteration, amendment or abbreviation or if it is issued in part or issued incomplete in any way.

Scale at A3: 1:5,000

Metres

© Crown copyright and database rights 2013.
Ordnance Survey Licence Number 100049190.

Doc Number: C252-ETM-EV-MAP-020-002570-P03.00

Date: 06/09/13

Reproduced from Ordnance Survey's 1:25 000 map of 1998 with the permission of the controller of Her Majesty's Stationery Office. Crown Copyright reserved. Licence No: AL 50125A
Licencee: Stratascan Ltd. Vineyard House Upper Hook Road Upton Upon Severn WR8 0SA
OS 100km square = SP



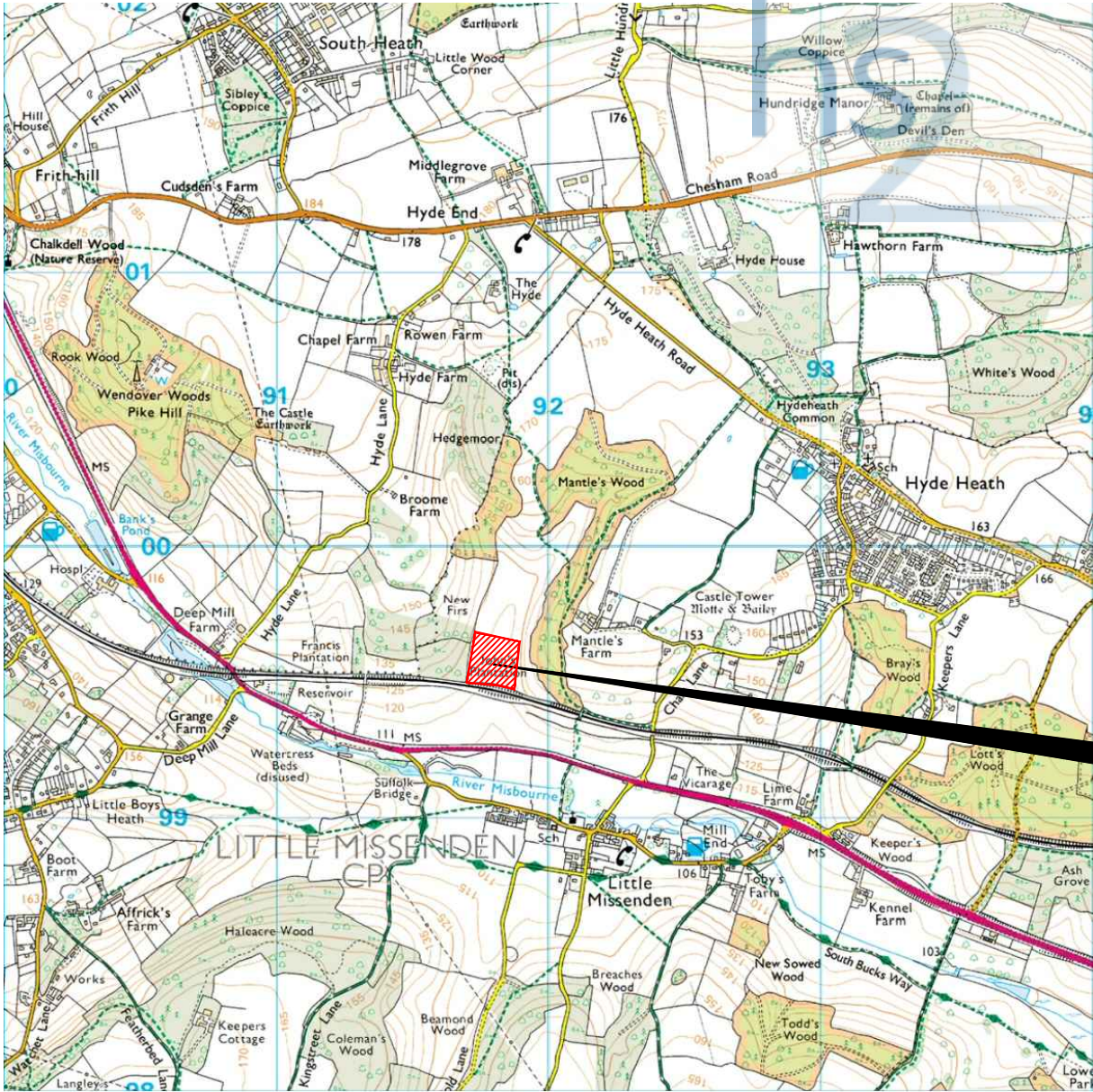
02

01

00

99

98



Survey Area

90

91

92

93

94

Amendments

Issue No.	Date	Description
-	-	-
-	-	-

© Stratascan Ltd - 2013

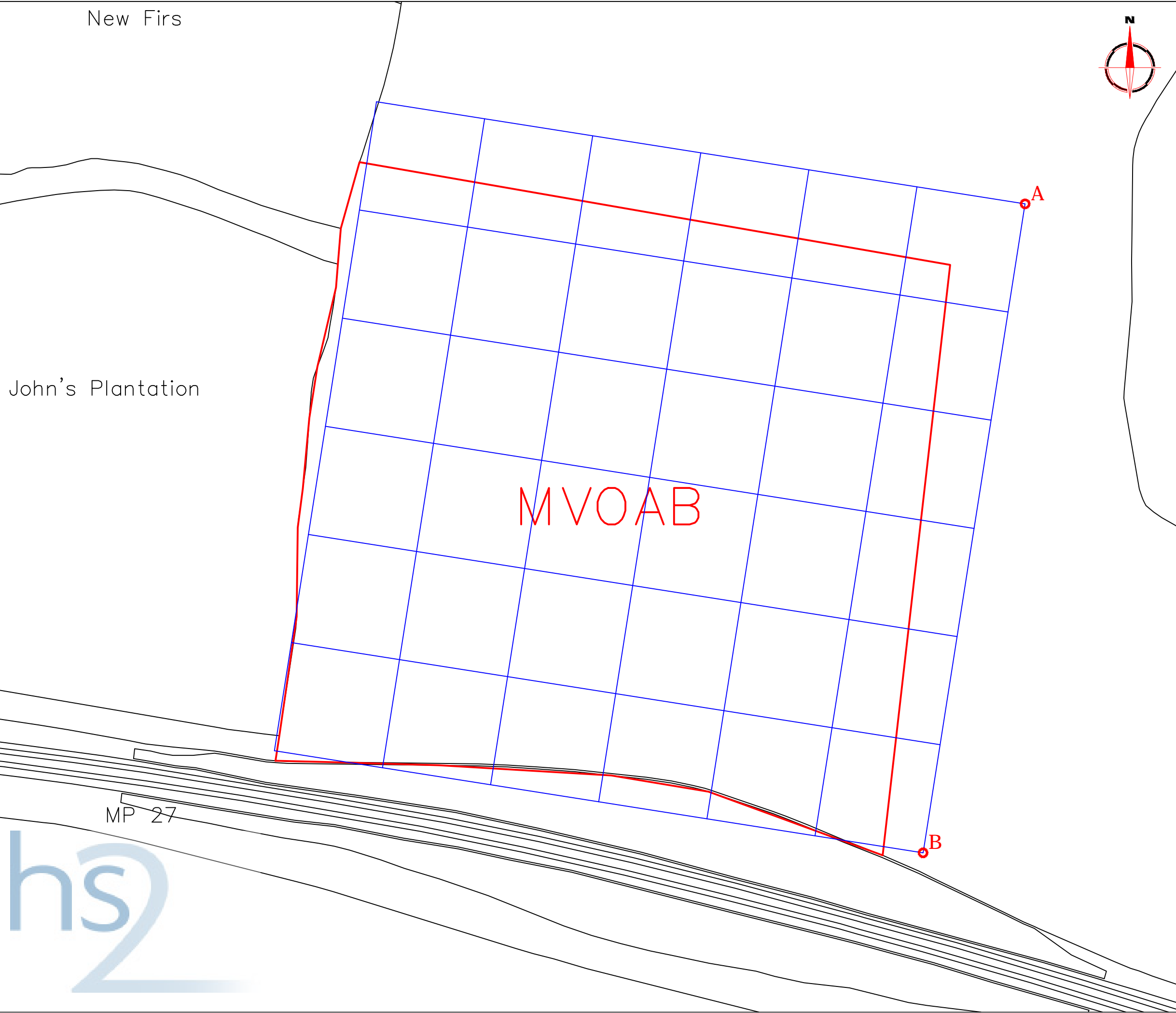












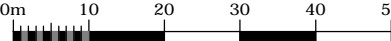
Site centred on NGR	SU 917 005
Client	HS2 Ltd
Project Title	Job No. J3363-MVOAB
GEOPHYSICAL SURVEY - HS2 LONDON - WEST MIDLANDS: CFA 09 - AREA MVOAB - MANTLES WOOD	
Subject	LOCATION PLAN OF SURVEY AREA

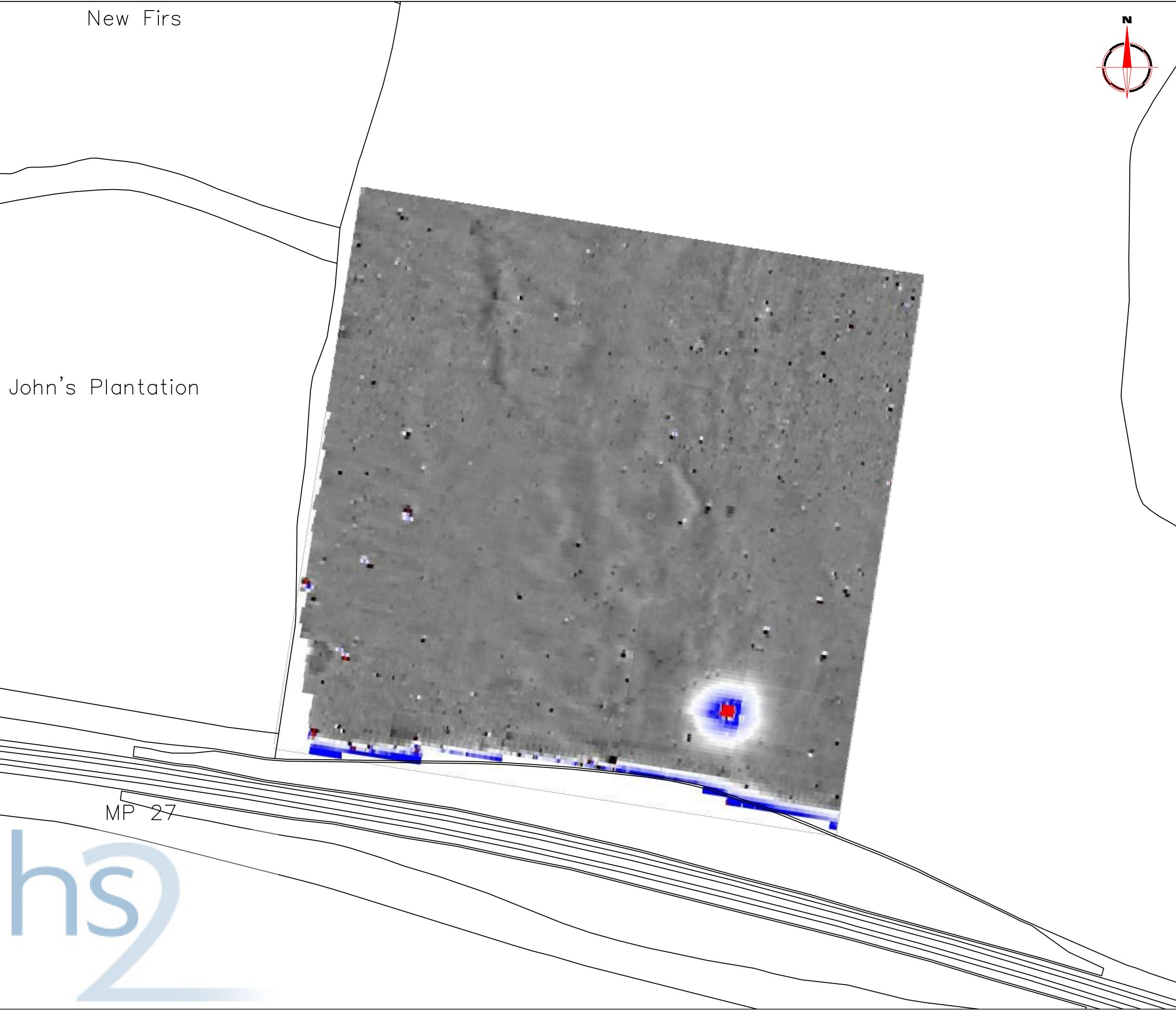
STRATASCAN™
GEOPHYSICS FOR ARCHAEOLOGY
AND ENGINEERING
VINEYARD HOUSE
UPTON UPON SEVERN
WR8 0SA
T: 01684 592266
E: info@stratascan.co.uk
www.stratascan.co.uk



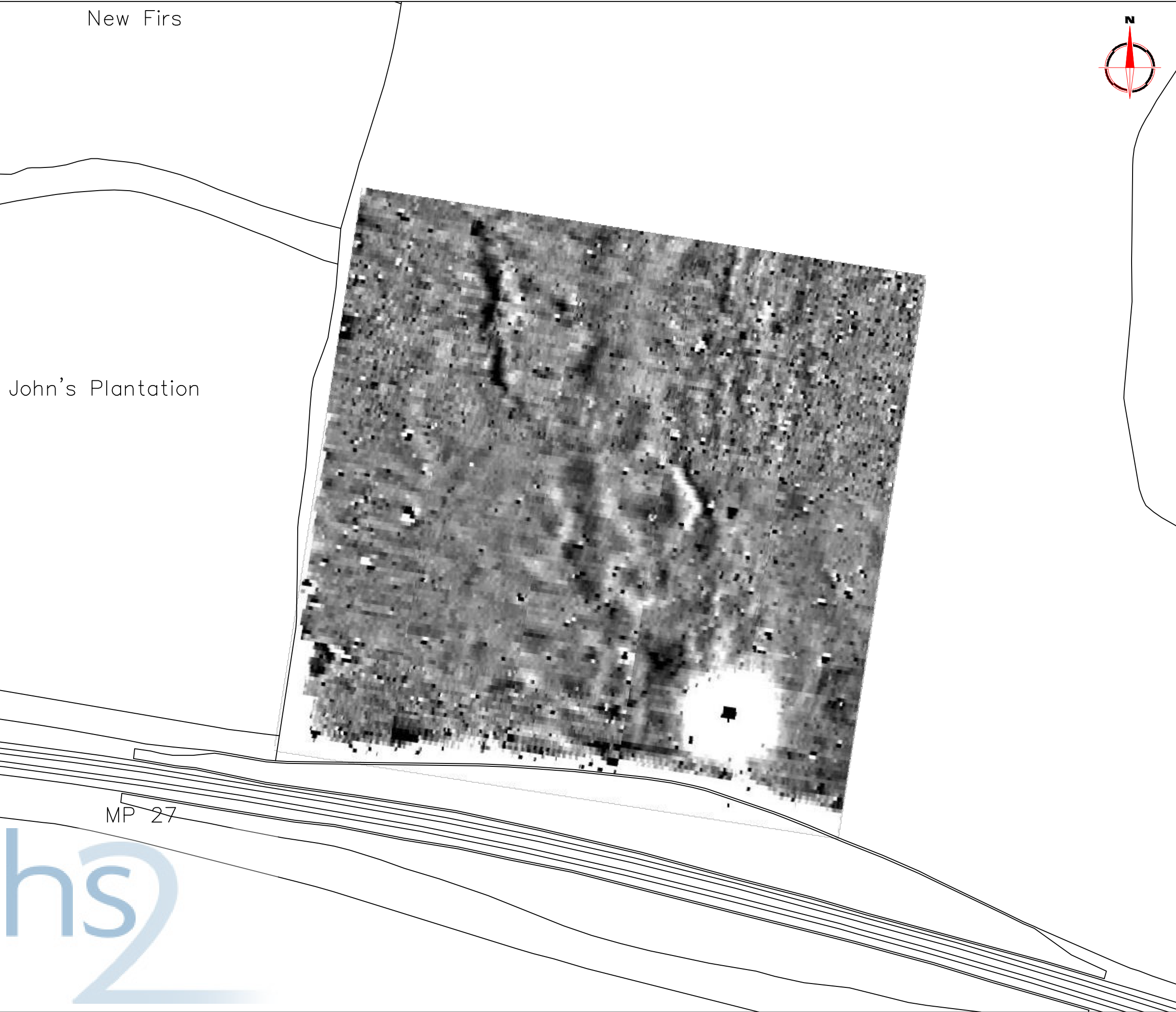
Scale	1:25000		0m	500	1000m
Plot	A3	Checked by	DGE	Issue No.	01
Survey date	JUNE 2013	Drawn by	BPM	Figure No.	CH-004-09.06



Amendments		
Issue No.	Date	Description
-	-	-
-	-	-
© Stratascan Ltd - 2013		
KEY		
	Survey area	
	Survey grid	
	GPS referencing point	
OS GRID REFERENCES		
A	491901.48, 199654.20	
B	491873.51, 199476.38	
Client		
HS2 Ltd		
Project Title		
J3363-MVOAB		
Job No.		
GEOPHYSICAL SURVEY - HS2		
LONDON - WEST MIDLANDS: CFA 09		
- AREA MVOAB - MANTLES WOOD		
Subject		
LOCATION OF SURVEY GRIDS AND		
REFERENCING		
		
GEOPHYSICS FOR ARCHAEOLOGY		
AND ENGINEERING		
VINEYARD HOUSE		
T: 01684 592266		
UPTON UPON SEVERN		
E: info@stratascan.co.uk		
WR8 0SA		
www.stratascan.co.uk		
		
		
SUMO GROUP MEMBER		
		
		
		
		
Scale		
1: 1000		
		
Plot		Issue No.
A3		01
Survey date		Figure No.
JUNE 2013		CH-004-09.07
Checked by		
DGE		
Drawn by		
BPM		

















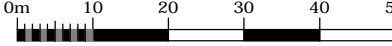


Amendments		
Issue No.	Date	Description
-	-	-
-	-	-
© Stratascan Ltd - 2013		
<div>Plotting parameters</div> <div>Maximum + 100nT (red)</div> <div>Minimum - 100nT (blue)</div> <div><div></div><div>+ 100nT</div><div>- 10nT</div><div>- 10nT</div><div>- 100nT</div></div>		
Client		
HS2 Ltd		
Project Title		Job No. J3363-MVOAB
GEOPHYSICAL SURVEY - HS2 LONDON - WEST MIDLANDS: CFA 09 - AREA MVOAB - MANTLES WOOD		
Subject		
COLOUR PLOT OF GRADIOMETER DATA SHOWING EXTREME VALUES		
<div>STRATASCAN™</div> <div>GEOPHYSICS FOR ARCHAEOLOGY AND ENGINEERING</div> <div>VINEYARD HOUSE T: 01684 592266 UPTON UPON SEVERN E: info@stratascan.co.uk WR8 0SA www.stratascan.co.uk</div> <div><div>EUROPEAN GPR ASSOCIATION</div><div>sumo Survey Services</div><div>SUMO GROUP MEMBER</div><div>ims ISO 9001 certified</div><div>UKAS QUALITY MANAGEMENT 9001</div><div>ims ISO 14001 certified</div><div>UKAS ENVIRONMENTAL MANAGEMENT 14001</div></div> <div>Scale 1: 1000</div> <div>0m 10 20 30 40 50</div>		
Plot	Checked by	Issue No.
A3	DGE	01
Survey date	Drawn by	Figure No.
JUNE 2013	BPM	CH-004-09.08



Amendments		
Issue No.	Date	Description
-	-	-
-	-	-
© Stratascan Ltd - 2013		



Amendments		
Issue No.	Date	Description
-	-	-
-	-	-
© Stratascan Ltd - 2013		
KEY		
	Archaeology (discrete / zone / trend*) *trend = very weak response	
	Possible Archaeology (discrete / zone / trend*) *trend = very weak response	
	Industrial, Burnt-Fired	
	Old Field Boundary	
	Agriculture - Ridge & Furrow	
	Agriculture - Ploughing	
	Agriculture - Drain	
	Natural	
	Uncertain Origin (discrete / zone / trend*) *trend = very weak response	
	Pipe	
	Ferrous (discrete / zone)	
Client		
HS2 Ltd		
Project Title		Job No. J3363-MVOAB
GEOPHYSICAL SURVEY - HS2		
LONDON - WEST MIDLANDS: CFA 09		
- AREA MVOAB - MANTLES WOOD		
Subject		
ABSTRACTION AND INTERPRETATION OF GRADIOMETER ANOMALIES		
		
GEOPHYSICS FOR ARCHAEOLOGY AND ENGINEERING		
VINEYARD HOUSE		T: 01684 592266
UPTON UPON SEVERN		E: info@stratascan.co.uk
WR8 0SA		www.stratascan.co.uk
		
		
		
		
Scale		
1: 1000		
		
Plot	Checked by	Issue No.
A3	DGE	01
Survey date	Drawn by	Figure No.
JUNE 2013	BPM	CH-004-09.10